Introduction

The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) conducts environmental monitoring on and around the Savannah River Site (SRS) to accomplish several objectives: to understand the presence and movement of contaminants from the SRS; to quantify those contaminants; to determine the impact to the communities surrounding the SRS; to provide a means of evaluating data reported by the Department of Energy-Savannah River (DOE-SR); and to provide the public with a source of information independent from the DOE-SR that evaluates radiological and non-radiological contaminants in the environment stemming from present, past and future SRS operations and facilities.

The ESOP environmental surveillance network includes: calculating dose to the public from SRS releases; determining Radiological Atmospheric Quality Adjacent to SRS; monitoring Groundwater Quality Adjacent to the SRS; Drinking Water Quality Monitoring; Radiological Surface Water and Sediment Surveillance; Non-Radiological Sediment and Surface Water Quality Monitoring; Radiological Surveillance of Surface Soils On and Adjacent to the SRS; Radiological Monitoring of Terrestrial and Edible Vegetation On and Adjacent to SRS; Radiological Monitoring of Dairy Milk; Radiological Monitoring of Fish in the Savannah River; Game Animal Monitoring Adjacent to SRS; Oversight Monitoring and Support Activities associated with Deactivation & Decommission (D& D) activities and site clean up activities.

The implementation of radiological and non-radiological surveillance monitoring by ESOP has resulted in a significant increase in our understanding of the concentrations and movement of radioactive contaminants in the environment on and around the SRS. The knowledge gained aids in tracking releases from Site facilities, identifying and quantifying pathways for potential exposure and coordinating with emergency responders for more effective emergency planning. ESOP is also actively involved in field oversight projects to verify the validity and effectiveness of monitoring activities at Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites and D & D sites. Additional projects are being considered to provide information for new proposed SRS facilities, fill data gaps, and evaluate other SRS non-regulatory monitoring programs. The on-going improvements in monitoring capabilities underscore the commitment by the SCDHEC to fulfill its mission to protect the public health and the environment, reinforcing the DOE's commitment to improving open communication and cooperation with host states.

For 2004, the ESOP monitored pathways for human exposure to radiological contaminants from the SRS. In general, the SCDHEC ESOP results indicate that while there continues to be a measurable impact on the environment from the SRS, the values are, in most cases, below established Federally mandated contaminant guidelines, and the results are consistent with those values reported by the DOE-SR.

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List of Acronyms

AGMN	Ambient Groundwater Monitoring Network
AGMP	Ambient Groundwater Monitoring Program
ASD	Analytical Services Division
BDC	Beaver Dam Creek
BNL	Brookhaven National Laboratory
BNA	Base Neutral Acid Extractable
BOD	Biochemical Oxygen Demand
CAB	Citizens Advisory Board
CDC	Centers for Disease Control
Coef. Var.	Coefficient of variation
CSWTF	Central Sanitary Wastewater Treatment Facility
DCG	Derived Concentration Guide
DER	Duplicate Error Ratio
DIL	Derived Intervention Level
DRF	Dose Reduction Factor
DO	Dissolved Oxygen
DOE-SR	Department of Energy-Savannah River
DWPF	Defense Waste Processing Facility
EMS	Environmental Monitoring Section (Westinghouse Savannah River Company)
EPA	Environmental Protection Agency
ERAMS	Environmental Radiation Monitoring Systen (EPA)
ESD	Edisto Savannah District
ESOP	Environmental Surveillance and Oversight Program
ETF	Effluent Treatment Facility
EQC	Environmental Quality Control
FAO	Food and Agricultural Organization of the United Nations
FDA	Food and Drug Administration
FGR	Federal Guidance Regulations
FMC	Fourmile Creek
GAL	Generic Action Levels
GEL	General Engineering Laboratories
GIS	Geographical Information System
GPS	Global Positioning System
GW	Groundwater
HEPA	High Efficiency Particulate Arresting
ICRP	International Commission on Radiological Protection
LLD	Lower Limit of Detection
LOD	Limit of Detection
LLNL	Lawrence Livermore National Laboratory
ESD	Edisto Savannah District (formerly Lower Savannah District)
LT	Less than or “<”
LTR	Lower Three Runs Creek
MB	McQueen Branch
MCL	Maximum Contaminant Level
MFC	Membrane Fecal Coliform
MDA	Minimum Detectable Activity

List of Acronyms

MDC	Minimum Detectable Concentration
MDL	Minimum Detection Level
MEI	Maximally Exposed Individual
MFFF	Mixed Oxide Fuel Fabrication Facility
N	Number of samples
NCRP	National Council on Radiation Protections and Measurement
NH3 NH4	Ammonia
NORM	Naturally Occurring Radioactive Material
NPDES	National Pollutant Discharge Elimination System
NO2 NO3	Nitrate/Nitrite
NRC	Nuclear Regulatory Commission
NSBLD	New Savannah Bluff Lock & Dam
ORNL	Oak Ridge National Laboratory
ORWBG	Old Radioactive Waste Burial Ground
PCBs	Polychlorinated Biphenyls
PRG	Preliminary Remedial Goal
PWS	Public Water System
QA/QC	Quality Assurance/Quality Control
R	dry/wet weight ratio
RAC	Risk Assessment Corporation
RBA	Risk-based Activity
REMD	Radiological Environmental Monitoring Division
RMBL	Regulatory Monitoring and Bioassay Lab
RW	River Water
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SD	Std. Dev. or Standard Deviation
SOP	Standard Operating Procedure
SREL	Savannah River Ecology Laboratory
SRL	Savannah River Laboratory
SRS	Savannah River Site
SRTC	Savannah River Technology Center
STC	Steel Creek
Std. Dev.	Standard deviation
STEVENS	Stevens Creek
STL	Severn-Trent Laboratories
STOKES	Stokes Bluff Landing
SW	Surface Water
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
TKN	Total Kjeldahl Nitrogen
TLD	Thermoluminescent Dosimeter
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

List of Acronyms

US 301	United States Highway 301
UTR	Upper Three Runs Creek
VEGP	Vogtle Electrical Generating Plant
VOCs	Volatile Organic Compounds
WHO	World Health Organization
WSRC	Westinghouse Savannah River Company

Units of Measure

cm	centimeter
g/cm^3	grams per cubic centimeter
hrs/day	hours per day
hrs/yr	hours per year
kg/yr	kilograms per year
L	Liter
L/hr	Liters per hour
L/yr	Liters per year
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/L	milligrams per Liter
ml	milliliter
mrem	millirem
m^3/yr	cubic meters per year
pCi/L	picocuries/liter
pCi/g	picocuries/gram
pCi/m^3	picocuries per cubic meter
ppb	parts per billion
ppm	part per million
person-rem/y	person-roentgen equivalent man per year
g/L	grams/liter
U	<MDA
ug/g	micrograms/gram
ug/L	micrograms/liter
TU	Tritium unit or 3.2 pCi/L or 7.1 dpm/L

List of Acronyms

Radionuclides and Associated Half-Lives

Ac-228	Actinium-228	6.1 hours (h)
Am-241	Americium-241	432 years (y)
Ar-41	Argon-41	1.83 h
C-14	Carbon-14	5730 y
Ce-144	Cerium-144	284 days (d)
Cs-134	Cesium-134	2.06 y
Cs-137	Cesium-137	30.1 y
Cm-242	Curium-242	163 d
Cm-243	Curium-243	28.5 y
Cm-244	Curium-244	18.1 y
Cm-245	Curium-245	8.5E3 y
Cm-246	Curium-246	4.75E3 y
Co-57	Cobalt-57	271 d
Co-60	Cobalt-60	5.27 y
Eu-154	Europium-154	8.8 y
Eu-155	Europium-155	4.96 y
H-3	Hydrogen-3 (tritium)	12.3 y
I-129	Iodine-129	1.57E7 y
I-131	Iodine-131	8.04 d
I-133	Iodine-133	20.9 h
K	Potassium-40	1.27E9 y
Kr-85	Krypton-85	10.7 y
Mg-54	Magnesium-54	312.5 d
Na-22	Sodium-22	2.6 y
Nb-95	Niobium-95	35.0 d
Ni-63	Nickel-63	100y
Np-237	Neptunium-237	2.14E6 y
Pb-212	Lead-212	10.64 h
Pb-214	Lead-214	27 m
P-32	Phosphorus-32	14.3 d
Pm-146	Promethium-146	5.5 y
Pu-238	Plutonium-328	87.7 y
Pu-239	Plutonium-329	2.4E4 y
Pu-240	Plutonium-240	6.5E3 y
Ra-226	Radium-226	14.8 d
Ra-228	Radium-228	5.75 y
Ru-103	Ruthenium-103	39 d
Ru-106	Ruthenium-106	1.00 y
S-35	Sulfur-35	87.4 d
Se-79	Selenium-79	6.5E4 y
Sb-125	Antimony-125	2.77 y
Sn-113	Tin-113	115 d
Sn-126	Tin-126	1.0E5 y
Sr-89	Strontium-89	50.6 d

List of Acronyms

Sr-90	Strontium-90	28.8 y
Tc-99	Technetium-99	2.13E5 y
Th-228	Thorium-228	1.9 y
Th-230	Thorium-230	7.7E4 y
Th-232	Thorium-232	1.41E4 y
Th-234	Thorium-234	24.1 d
Tl-208	Thallium-208	3.05 minutes
U-233	Uranium-233	1.59E5 y
U-234	Uranium-234	2.44E5 y
U-235	Uranium-235	7.03E8 y
U-238	Uranium-238	4.47E9 y
Y-91	Yttrium-91	58 d
Zn-65	Zinc-65	244 d
Zr-95	Zirconium-95	64.0 d

Sampling Location Information

Note: Quadrant locations for DOE-SR Environmental perimeter random soil samples collected in 2004. These locations were randomly selected from a quadrant system established by the U.S. Department of Interior on a 7.5' topographical map of South Carolina revision 10/92.

DOE-SR Environmental Perimeter		**Quadrant (Quad) Limits**
Random Quadrants Within SRS Perimeter "E"		
Quad Designation	**7.5' Quad Name**	**Latitude by Lat and Longitude by Long**
E1X	Furman	3237.5 by 3245 and -8107.5 by -8115
E2	Barnwell	3307.5 by 3315 and -8115 by -8122.5
E3X	New Ellenton, SE	3315 by 3322.5 and -8130 by -8137.5
E4	Aiken	3330 by 3337.5 and -8137.5 by -8145
E5	Ehrhardt	3300 by 3307.5 and -8100 by -8107.5
E6	Foxtown	3337.5 by 3345 and -8130 by -8137.5
E7X&B24X	Emory	3352.5 by 3400 and -8137.5 by -8145
E8	HarleysMillPond	3330 by 3337.5 and -8107.5 by -8115
E9	Monetta	3345 by 3352.5 and -8130 by -8137.5
E10	Norway West	3322.5 by 3330 and -8107.5 by -8115
E11	North	3330 by 3337.5 and -8100 by -8107.5
E12	Colliers	3337.5 by 3345 and -8200 by -8207.5
E13	Norway East	3325.5 by 3330 and -8100 by -8107.5
E14X	Jackson	3315 by 3322.5 and -8145 by -8152.5
E15X	Evans	3330 by 3337.5 and -8207.5 by -8215
E16	Denmark	3315 by 3322.5 and -8107.5 by -8115
E17X&B25X	Orangeburg S.	3322.5 by 3330 and -8045 by -8052.5
E18	Midway	3315 by 3322.5 and -8052.5 by -8100
E19X	Mechanics Hill	3315 by 3322.5 and -8152.5 by -8200
E20	Kitchens Mill	3330 by 3337.5 and -8122.5 by -8130
E21	Clear Pond	3307.5 by 3315and -8100 by -8107.5
E22X&B26X	Grays	3237.5 by 3245 and -8100 by -8107.5
E23	Kildaire	3230 by 3237.5 and -8122.5 by -8130
E24	Long Branch	3315 by 3322.5 and -8122.5 by -8130
E25	Clarks Hill	3337.5 by 3345 and -8207.5 by -8215
E26X&B27X	Parksville	3345 by 3352.5 and -8207.5 by -8215
E27	Roper's Crossroads	3337.5 by 3345 and -8152.5 by -8200
E28	Salley	3330 by 3337.5 and -8115 by -8122.5
E29	Allendale	3300 by 3307.5 and -8115 by -8122.5
E30	Graniteville	3330 by 3337.5 and -8145 by -8152.5
E31	Oakwood	3330 by 3337.5 and -8130 by -8137.5

1. The randomly selected quadrants are from a United States Department of Interior 7.5 Minute Topographic Map Printed by the South Carolina Land Resources Commission, Rv 10/92.
2. "**X**" in any designated ID represents the presence of an **exclusion zone** of either a state border, 50 mi. limit bisector line that splits the quad area into an environmental side and a background side, or occurrence of random pick area within 10 miles of a nuclear facility.
3. "**E**" means this is a pick selected for SRS perimeter random environmental sampling.
4. "**B**" means this is a background pick outside of the 50 mile SRS perimeter limit.

Sampling Location Information

Note: Quadrant locations for South Carolina background random soil samples collected in 2004. These locations were randomly selected from a quadrant system established by the U.S. Department of Interior on a 7.5’ topographical map of South Carolina revision 10/92.

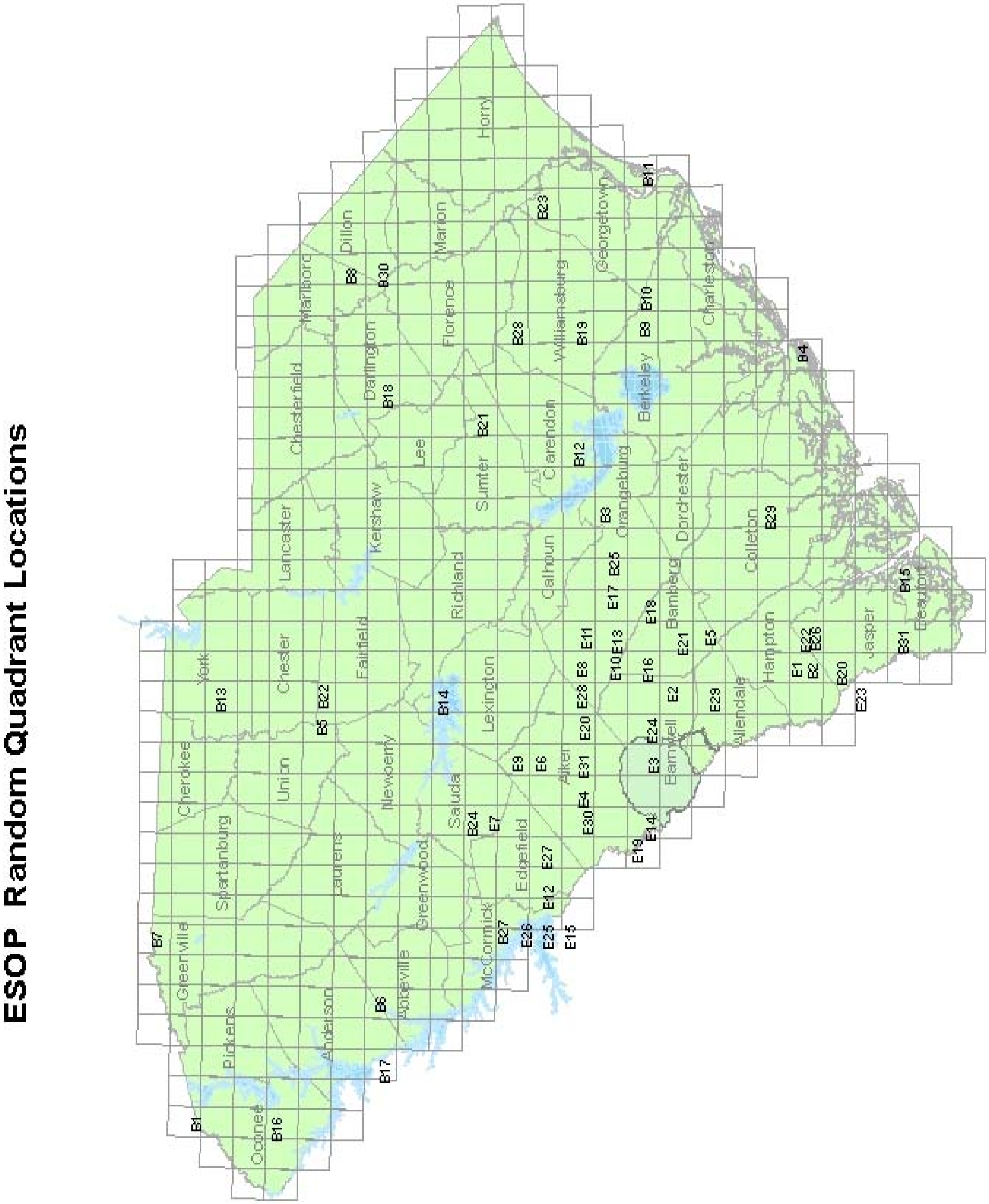
South Carolina Background		**Quadrant (Quad) Limits**
Random Quadrants for the S.C. Bkg "B"		**Outside of the 50-mile SRS Perimeter Zone.**
Quad Designation	**7.5' Quad Name**	**Latitude by Lat and Longitude by Long**
B1X	Cashiers	3500 by 3507.5 and -8300 by -8307.5
B2X&E1X	Furman	3237.5 by 3245 and -8107.5 by -8115
B3	Felderville	3322.5 by 3330 and -8030 by -8037.5
B4	James Is.	3237.5 by 3245 and -7952.5 by -8000
B5	Carlisle	3430 by 3437.5 and -8122.5 by -8130
B6	Antreville	3415 by 3422.5 and -8230 by -8237.5
B7X	Saluda	3507.5 by 3515 and -8215 by -8222.5
B8	Bingham	3422.5 by 3430 and -7930 by -7937.5
B9	Alvin	3315 by 3322.5 and -7945 by -7952.5
B10	Jamestown	3315 by 3322.5 and -7937.5 by -7945
B11	North Is.	3315 by 3322.5 and -7907.5 by -7915
B12	Summerton	3330 by 3337.5 and -8015 by -8022.5
B13	Sharon	3452.5 by 3500 and -8115 by -8122.5
B14X	Lake Murray E	3400 by 3407.5 and -8115 by -8122.5
B15	Spring Is.	3215 by 3222.5 and -8045 by -8052.5
B16X	Westminster	3437.5 by 3445 and -8300 by -8307.5
B17X	Hartwell Dam	3415 by 3422.5 and -8245 by -8252.5
B18X	Hartsville South	3415 by 3422.5 and -8000 by -8007.5
B19	Salters	3330 by 3337.5 and -7945 by -7952.5
B20X	Pineland	3230 by 3237.5 and -8107.5 by -8115
B21	Mayesville	3352.5 by 3400 and -8007.5 by -8015
B22	Carlisle SE	3430 by 3437.5 and -8115 by -8122.5
B23	Outland	3337.5 by 3345 and -7915 by -7922.5
B24X&E7X	Emory	3352.5 by 3400 and -8137.5 by -8145
B25X&E17X	Orangeburg S.	3322.5 by 3330 and -8045 by -8052.5
B26X&E22X	Grays	3237.5 by 3245 and -8100 by -8107.5
B27X&E26X	Parksville	3345 by 3352.5 and -8207.5 by -8215
B28	Lake City West	3345 by 3352.5 and -7945 by -7952.5
B29	Neyles	3245 by 3252.5 and -8030 by -8037.5
B30	Oak Grove	3415 by 3422.5 and -7930 by -7937.5
B31	Hardeeville	3215 by 3222.5 and -8100 by -8107.5

1. The randomly selected quadrants are from a United States Department of Interior 7.5 Minute Topographic Map Printed by the South Carolina Land Resources Commission, Rv 10/92.
2. "**X**" in any designated ID represents the presence of an **exclusion zone** of either a state border, 50 mi. limit bisector line that splits the quad area into an environmental side and a background side, or occurrence of random pick area within 10 miles of a nuclear facility.
3. "**E**" means this is a pick selected for SRS perimeter random environmental sampling.
4. "**B**" means this is a background pick outside of the 50 mile SRS perimeter limit.

Sampling Location Information

Sampling Location Information

Map 1. Savannah River Site perimeter and South Carolina background random sampling locations.



1.1 Radiological Atmospheric Quality Adjacent to Savannah River Site

1.1.1 Summary

This project provides independent quantitative monitoring of atmospheric radionuclide releases associated with the Savannah River Site (SRS). It also provides monitoring of atmospheric media on a routine basis to measure radionuclide concentrations in the surrounding environment and to identify trends that may require further investigation. Radiological atmospheric monitoring sites are established to provide spatial coverage of the project area (Map 2, section 1.1.2).

South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) air monitoring capabilities in 2004 included air-monitoring stations with the capacity for sample collection of glass fiber filters, precipitation, and silica gel columns, and thermoluminescent dosimeters (TLDs). The glass fiber filters were used to collect total airborne particulates. Particulates were screened weekly for gross alpha and gross beta emitting activity. Precipitation, when present, was sampled and analyzed monthly for tritium. Silica gel distillates of atmospheric moisture were analyzed monthly for tritium. Fourth quarter glass filters were composited and analyzed for specific radioisotopic particulates. TLDs were collected and analyzed every quarter for ambient beta/gamma levels. ESOP emphasizes monitoring for radionuclides in atmospheric media around the SRS at potential public exposure locations.

ESOP data collected substantiated historically reported Department of Energy-Savannah River (DOE-SR) values for radionuclides in the ambient environment at or near the SRS boundary.

In general, average ESOP atmospheric radiological monitoring results at the SRS boundary are slightly different than DOE-SR reported average values. Variations in atmospheric radiological monitoring results between ESOP and DOE-SR are likely a result of differences in monitoring locations, local meteorological conditions, and number of locations.

In summary, no United States Environmental Protection Agency (EPA) air standards were exceeded at the monitored locations and there were no elevations of radiological pollutant concentrations associated with SRS operations. Sampling results by ESOP indicate that SRS activities had a measurable impact for tritium, but a negligible impact on local air quality.

RESULTS AND DISCUSSION

Total Suspended Particulates

Routine weekly data for TSP and radiochemical data can be found in section 1.1.4.

Alpha

During the 2004 sampling period, gross alpha activity ranged from 0.001 to 0.008 pCi/m^3. Values in this range are typically associated with naturally occurring alpha-emitting radionuclides, primarily as decay products of radon (Kathren 1984), and are considered normal.

If gross alpha counts are above the range of 0.7 pCi/m^3, which is the action level according to Rhonda Sears of The United States Environmental Protection Agency (EPA), the filters are analyzed for specific radioisotopes. The average gross alpha nuclide concentration in 2004 was 0.003 pCi/m^3.

Beta

During the 2004 sampling period, gross beta concentrations ranged from 0.008 to 0.093 pCi/m^3. Values in this range are typically associated with naturally occurring beta-emitting radionuclides, primarily as decay products of radon (Kathren 1984). Small seasonal variations at each monitoring location have been consistent with historically reported ESOP values (SCDHEC 2004). The EPA, Office of Radiation and Indoor Air, uses gross beta counts as an indicator to determine if additional analyses will be performed. A gamma scan is done if the gross beta activity exceeds 1 pCi/m^3. This is the tiering of definitive analyses that is used for all total suspended particulate sampling associated with the Environmental Radiation Ambient Monitoring System (ERAMS). The ERAMS is comprised of a nationwide network of sampling stations that identify trends in the accumulation of long-lived radionuclides in the environment (U.S. EPA 2004). Figure 1 in section 1.1.3 shows average gross beta activity for SRS perimeter locations and illustrates trending of gross beta values for ESOP and DOE-SR (WSRC 2005). The average gross beta concentration reported by ESOP in 2004 was 0.023 pCi/m^3.

Radiochemical Particulates

Fourth quarter glass filters were analyzed for plutonium-238, plutonium-239/40, americium-241, and strontium-89/90 in 2004. All analytical results for these radioisotopes were below Minimum Detectable Activity (MDA) or below the Reporting Limit of Severn Trent Laboratory.

Ambient Beta/Gamma

ESOP conducts ambient beta/gamma monitoring through the deployment of TLDs around the perimeter of the SRS. During the sampling period, ESOP external radiation levels at monitored locations were lower than levels reported by DOE-SR (WSRC 2005). Ambient beta/gamma levels measured with TLDs are provided for all quarters of 2004 in section 1.1.4. It should be noted that 4 mrem are subtracted from the reported result for each TLD to account for the transcontinental flight from South Carolina to California and back (Walter 1995). Corrected values are reported in section 1.1.4. The average ambient beta/gamma activity in 2004 was 28.0 mrems.

Figure 2 in section 1.1.3 shows trends at the SRS perimeter for averaged ambient beta/gamma values for DOE-SR (WSRC 2005) and ESOP. ESOP averaged ambient beta/gamma values for 1999 and 2000 represent three quarters of data while all others represent four quarters.

Tritium

Tritium in air values reported by ESOP are the result of using the historical means of calculating an air concentration of tritium based on a generic absolute humidity of 11.5 grams of atmospheric moisture per cubic meter section 1.1.4 includes ESOP atmospheric moisture data analyzed in 2004. Averaged ESOP air tritium activity was consistently lower than the DOE-SR measured activity although well within the same order-of-magnitude.

Average atmospheric tritium activity at the SRS perimeter reported by ESOP for 2004 was higher than for 2003. Figure 3 in section 1.1.3 illustrates trending of atmospheric tritium activity for ESOP and DOE-SR as measured and calculated at the SRS perimeter.

The DOE-SR average measured value for tritium activity in air at the SRS boundary was 11.0 pCi/m^3 (WSRC 2005). The DOE-SR calculated value for tritium activity at the SRS boundary was 10.0 pCi/m^3 (WSRC 2005). The SCDHEC average measured activity for tritium was 6.0 pCi/m^3. DOE-SR average measured values for tritium in atmospheric moisture were higher than ESOP averaged measured values for the SRS perimeter (WSRC 2005). This may be attributed to a dilution that occurs when desiccants are used for collecting atmospheric moisture for tritium analysis. In a recent study, tritium concentrations in air, as determined using desiccants, can result in under-reporting of air tritium concentrations by factors of 1.4 to 2.6 (Rosson et al 2000). Prior to deployment in the field, silica-gel desiccant is dried to remove any moisture. However, a small percentage of water remains in the desiccant. This results in a slight dilution of the collected sample that is reflected in the distillate. DOE-SR has implemented a correction factor for tritium-in-air measurements using silica-gel (WSRC 2005). This could explain why the 2004 DOE-SR average measured activity is higher than ESOP average reported measured activity. Another factor that may contribute to the lower ESOP air tritium values is that only two of the monitoring stations are exactly on the SRS perimeter (property line), while the other three points used for this comparison are located approximately two miles from the SRS property line.

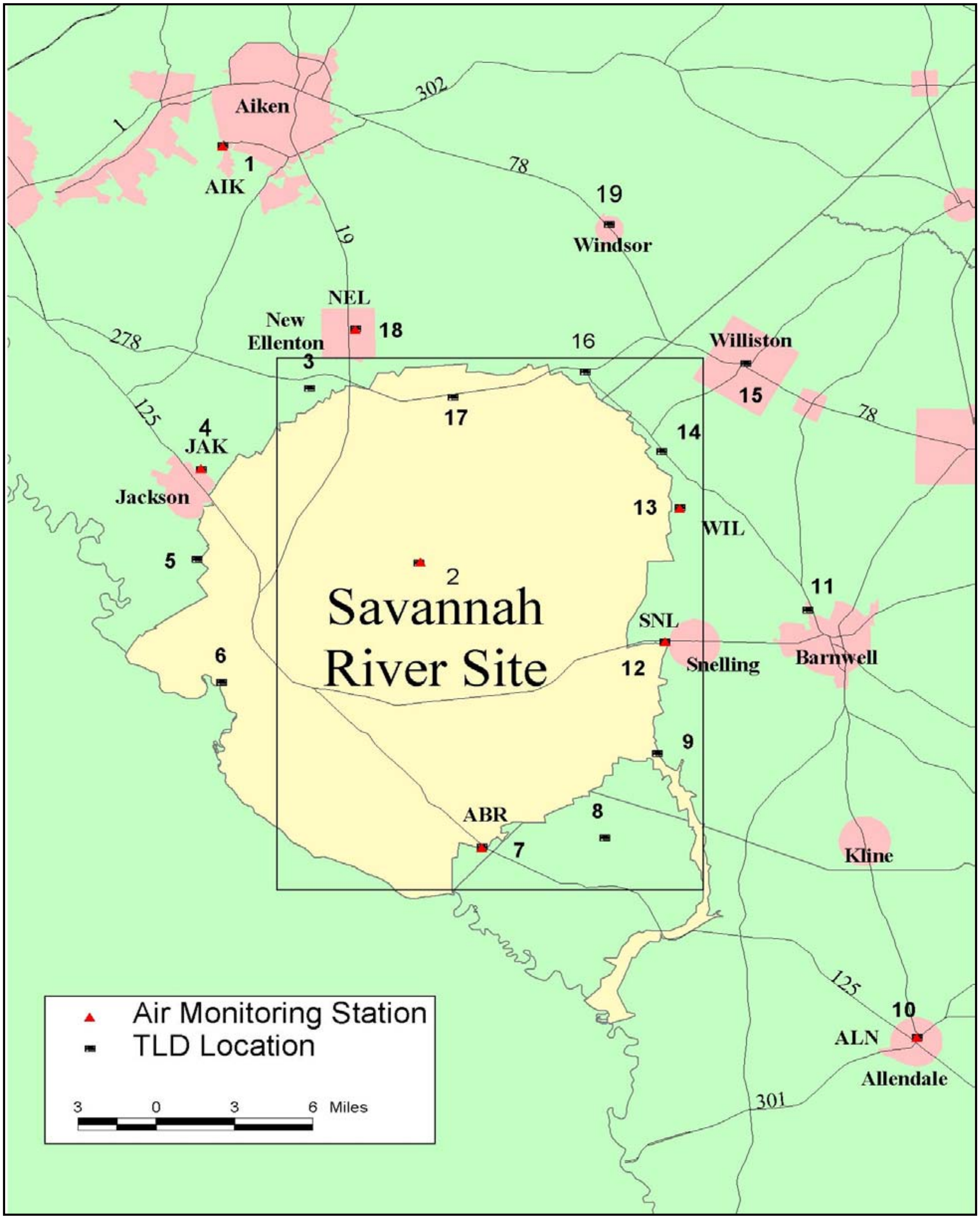
The majority of the analytical results for tritium in rainwater were below the LLD. The maximum reported value, 551 pCi/L from the New Ellenton, SC air monitoring station, was collected on August 3, 2004. Section 1.1.4 includes rainwater tritium data for all monitoring locations. Summary statistics are given in section 1.1.5.

CONCLUSIONS AND RECOMMENDATIONS

All ESOP data collected confirmed historically reported DOE-SR values for radionuclides in the ambient environment at the SRS boundary with no anomalous data noted for any monitored parameters. ESOP air and precipitation tritium data were consistently lower than the DOE-SR measured values, although within the same order-of-magnitude. The state of South Carolina, in conjunction with DOE-SR, is evaluating several ways to enhance monitoring of atmospheric tritium.

ESOP is planning to install additional equipment in the winter of 2004-2005 and modify air tritium calculations to account for the residual moisture in the desiccant matrix to more precisely account for actual air tritium concentrations. No EPA air standards were exceeded at the monitored locations and there were no elevations of radiological pollutant concentrations associated with SRS operations. Sampling results by ESOP indicate that SRS activities did have a measurable impact on local air quality.

1.1.2
Map 2. Radiological Atmospheric Monitoring Locations



1.1.3 Tables and Figures
Radiological Atmospheric Monitoring

Figure 1 Average Gross Beta for TSP at the SRS Perimeter

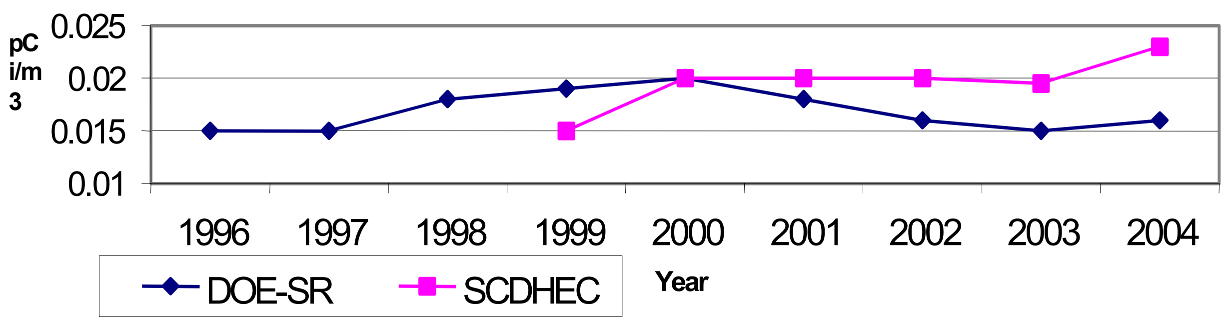


Figure 2 Average Ambient Beta/Gamma at the SRS Perimeter

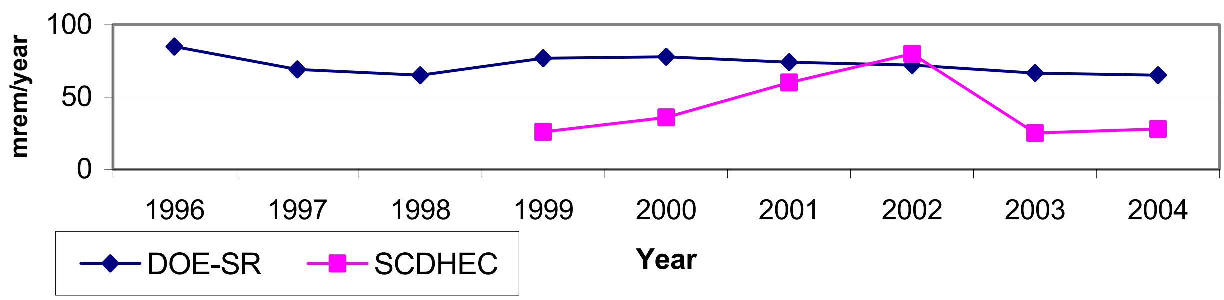
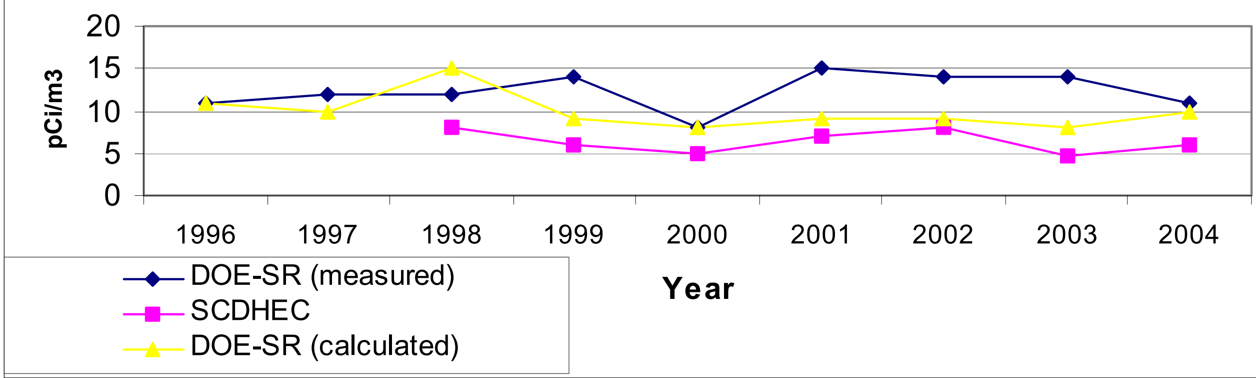


Figure 3 Average Atmospheric Tritium at the SRS Perimeter



1.1.4 Data
Radiological Atmospheric Monitoring Data

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Aiken Elementary Water Tower (AIK)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.004	0.001	0.017	0.001				
1/13/2004	0.005	0.001	0.024	0.002	304	93	<191	
1/20/2004	0.004	0.001	0.024	0.002				
1/28/2004	0.004	0.001	0.024	0.002				
2/3/2004	0.003	0.001	0.018	0.002				
2/10/2004	0.003	0.001	0.021	0.002				
2/17/2004	0.003	0.001	0.019	0.002				
2/24/2004	0.004	0.001	0.022	0.002				
3/3/2004	0.002	0.001	0.018	0.002	476	110	<194	
3/9/2004	0.003	0.001	0.019	0.002				
3/16/2004	0.003	0.001	0.020	0.002				
3/23/2004	0.003	0.001	0.020	0.002				
3/30/2004	0.003	0.001	0.015	0.001				
4/6/2004	0.002	0.001	0.015	0.001	255	87	<181	
4/13/2004	0.004	0.001	0.022	0.002				
4/20/2004	0.003	0.001	0.020	0.002				
4/27/2004	0.006	0.001	0.028	0.002				
5/4/2004	0.003	0.001	0.019	0.002	<186		<186	
5/11/2004	0.005	0.001	0.032	0.002				
5/18/2004	0.005	0.001	0.027	0.002				
5/25/2004	0.004	0.001	0.023	0.002				
6/1/2004	0.003	0.001	0.019	0.002	393	98	<196	
6/8/2004	0.004	0.001	0.021	0.002				
6/15/2004	0.003	0.001	0.013	0.001				
6/22/2004	0.003	0.001	0.016	0.002	210	88	227	89
6/29/2004	0.002	0.001	0.014	0.001				
7/6/2004	0.003	0.001	0.020	0.002				
7/14/2004	0.002	0.001	0.020	0.001	<201		<201	
7/20/2004	0.003	0.001	0.022	0.002				
7/27/2004	0.003	0.001	0.030	0.002				
8/3/2004	0.002	0.001	0.093	0.001	711	109	<191	
8/10/2004	0.002	0.001	0.021	0.002				
8/17/2004	0.002	0.001	0.013	0.001				
8/24/2004	0.003	0.001	0.023	0.002				
8/31/2004	0.002	0.001	0.021	0.002	219	91	<193	
9/8/2004	0.001	0.001	0.015	0.001				
9/15/2004	0.001	0.001	0.014	0.001				
9/21/2004	0.002	0.001	0.024	0.002				
9/28/2004	0.003	0.001	0.024	0.002	231	98	<198	
10/6/2004	0.007	0.001	0.038	0.002				
10/12/2004	0.005	0.001	0.032	0.002				
10/19/2004	0.003	0.001	0.023	0.002	192	87	<187	
10/26/2004	0.003	0.001	0.018	0.001				
11/3/2004	0.004	0.001	0.027	0.002				
11/9/2004	0.004	0.001	0.027	0.002				
11/17/2004	0.002	0.001	0.020	0.001	255	94	<198	
11/23/2004	0.004	0.001	0.025	0.002				
11/30/2004	0.002	0.001	0.015	0.001				
12/7/2004	0.005	0.001	0.029	0.002				
12/14/2004	0.003	0.001	0.019	0.002				
12/22/2004	0.004	0.001	0.018	0.001				
12/29/2004	0.003	0.001	0.020	0.002	<191		<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: New Ellenton, SC (NEL)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.003	0.008	0.020	0.001				
1/13/2004	0.007	0.001	0.029	0.002	632	106	<191	
1/20/2004	0.006	0.001	0.029	0.002				
1/28/2004	0.005	0.001	0.028	0.002				
2/3/2004	0.004	0.001	0.023	0.002				
2/10/2004	0.003	0.001	0.023	0.002				
2/17/2004	0.003	0.001	0.021	0.002				
2/24/2004	0.003	0.001	0.030	0.002				
3/3/2004	0.002	0.001	0.020	0.002	<194		221	91
3/9/2004	0.003	0.001	0.020	0.002				
3/16/2004	0.002	0.001	0.021	0.002				
3/23/2004	0.003	0.001	0.021	0.002				
3/30/2004	0.002	0.001	0.017	0.002				
4/6/2004	0.002	0.001	0.016	0.002	383	93	551	99
4/13/2004	0.003	0.001	0.024	0.002				
4/20/2004	0.003	0.001	0.020	0.002				
4/27/2004	0.006	0.001	0.029	0.002				
5/4/2004	0.003	0.001	0.016	0.002	474	99	339	93
5/11/2004	0.005	0.001	0.025	0.002				
5/18/2004	0.006	0.001	0.032	0.002				
5/25/2004	0.004	0.001	0.021	0.002				
6/1/2004	0.003	0.001	0.020	0.002	827	114	<196	
6/8/2004	0.003	0.001	0.023	0.002				
6/15/2004	0.002	0.001	0.013	0.001				
6/22/2004	0.002	0.001	0.019	0.002	747	109	<188	
6/29/2004	0.002	0.001	0.015	0.002				
7/6/2004	0.003	0.001	0.019	0.002				
7/14/2004	0.002	0.001	0.020	0.002	<201		<201	
7/20/2004	0.003	0.001	0.025	0.002				
7/27/2004	0.003	0.001	0.033	0.002				
8/3/2004	0.002	0.001	0.088	0.001	547	103	194	88
8/10/2004	0.003	0.001	0.023	0.002				
8/17/2004	0.002	0.001	0.015	0.002				
8/24/2004	0.002	0.001	0.017	0.002				
8/31/2004	0.002	0.001	0.017	0.002	347	96	<193	
9/8/2004	0.001	0.001	0.011	0.001				
9/15/2004	0.001	0.001	0.011	0.001				
9/21/2004	0.001	0.001	0.008	0.001				
9/28/2004	0.002	0.001	0.019	0.002	422	101	<198	
10/6/2004	0.006	0.001	0.040	0.002				
10/12/2004	0.006	0.001	0.036	0.002				
10/19/2004	0.003	0.001	0.025	0.002	305	92	<187	
10/26/2004	0.003	0.001	0.021	0.002				
11/3/2004	0.003	0.001	0.032	0.002				
11/9/2004	0.004	0.001	0.033	0.002				
11/17/2004	0.003	0.001	0.021	0.002	444	102	<198	
11/23/2004	0.003	0.001	0.029	0.002				
11/30/2004	0.002	0.001	0.018	0.002				
12/7/2004	0.006	0.001	0.035	0.002				
12/14/2004	0.003	0.001	0.020	0.002				
12/22/2004	0.004	0.001	0.022	0.002				
12/29/2004	0.004	0.001	0.023	0.002	403	97	<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Jackson, SC (JAK)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.004	0.001	0.020	0.002				
1/13/2004	0.005	0.001	0.031	0.002	522	102	<191	
1/20/2004	0.005	0.001	0.029	0.002				
1/28/2004	0.005	0.001	0.029	0.002				
2/3/2004	0.003	0.001	0.022	0.002				
2/10/2004	0.003	0.001	0.024	0.002				
2/17/2004	0.002	0.001	0.020	0.002				
2/24/2004	0.003	0.001	0.027	0.002				
3/3/2004	0.001	0.001	0.023	0.004	1160	124	281	93
3/9/2004	0.003	0.001	0.021	0.002				
3/16/2004	0.003	0.001	0.022	0.002				
3/23/2004	0.004	0.001	0.021	0.002				
3/30/2004	0.003	0.001	0.016	0.002				
4/6/2004	0.003	0.001	0.015	0.002	705	105	272	88
4/13/2004	0.003	0.001	0.023	0.002				
4/20/2004	0.002	0.001	0.021	0.002				
4/27/2004	0.006	0.001	0.029	0.002				
5/4/2004	0.003	0.001	0.019	0.002	359	94	264	90
5/11/2004	0.006	0.001	0.028	0.002				
5/18/2004	0.006	0.001	0.030	0.002				
5/25/2004	0.005	0.001	0.022	0.002				
6/1/2004	0.004	0.001	0.019	0.002	827	114	482	102
6/8/2004	0.004	0.001	0.020	0.002				
6/15/2004	0.002	0.001	0.015	0.002				
6/22/2004	0.003	0.001	0.015	0.002	620	104	305	92
6/29/2004	0.002	0.001	0.014	0.001				
7/6/2004	0.005	0.003	0.039	0.001				
7/14/2004	0.002	0.001	0.017	0.002	<201		<201	
7/20/2004	0.002	0.001	0.021	0.002				
7/27/2004	0.003	0.001	0.028	0.002				
8/3/2004	0.001	0.001	0.008	0.001	1451	132	318	94
8/10/2004	0.002	0.001	0.018	0.002				
8/17/2004	0.002	0.001	0.013	0.001				
8/24/2004	0.002	0.001	0.021	0.002				
8/31/2004	0.002	0.001	0.018	0.002	1145	124	213	90
9/8/2004	0.002	0.001	0.015	0.001				
9/15/2004	0.001	0.001	0.016	0.002				
9/21/2004	0.002	0.001	0.014	0.002				
9/28/2004	0.003	0.001	0.022	0.002	201	92	<198	
10/6/2004	0.005	0.001	0.032	0.002				
10/12/2004	0.005	0.001	0.031	0.002				
10/19/2004	0.004	0.001	0.022	0.002	300	92	<187	
10/26/2004	0.002	0.001	0.017	0.001				
11/3/2004	0.002	0.001	0.027	0.002				
11/9/2004	0.002	0.001	0.026	0.002				
11/17/2004	0.003	0.001	0.019	0.002	222	93	<198	
11/23/2004	0.003	0.001	0.023	0.002				
11/30/2004	0.001	0.001	0.015	0.001				
12/7/2004	0.005	0.001	0.029	0.002				
12/14/2004	0.002	0.001	0.018	0.002				
12/22/2004	0.003	0.001	0.019	0.001				
12/29/2004	0.003	0.001	0.019	0.002	290	93	<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Allendale Barricade (ABR)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.004	0.001	0.022	0.002				
1/13/2004	0.006	0.001	0.026	0.002	419	98.0	255	91
1/20/2004	0.005	0.001	0.028	0.002				
1/28/2004	0.005	0.001	0.027	0.002				
2/3/2004	0.003	0.001	0.022	0.002				
2/10/2004	0.003	0.001	0.023	0.002				
2/17/2004	0.003	0.001	0.020	0.002				
2/24/2004	0.003	0.001	0.030	0.002				
3/3/2004	0.002	0.001	0.022	0.002	602	105	295	94.0
3/9/2004	0.004	0.001	0.021	0.002				
3/16/2004	0.003	0.001	0.023	0.002				
3/23/2004	0.004	0.001	0.021	0.002				
3/30/2004	0.003	0.001	0.019	0.002				
4/6/2004	0.002	0.001	0.015	0.001	304	90	198	85
4/13/2004	0.003	0.001	0.022	0.002				
4/20/2004	0.003	0.001	0.020	0.002				
4/27/2004	0.005	0.001	0.027	0.002				
5/4/2004	0.004	0.001	0.019	0.002	236	89	<186	
5/11/2004	0.005	0.001	0.028	0.002				
5/18/2004	0.005	0.001	0.027	0.002				
5/25/2004	0.003	0.001	0.018	0.002				
6/1/2004	0.005	0.001	0.019	0.002	<196		<196	
6/8/2004	0.004	0.001	0.020	0.002				
6/15/2004	0.002	0.001	0.013	0.002				
6/22/2004	0.002	0.001	0.016	0.002	192	87	<188	
6/29/2004	0.001	0.001	0.015	0.002				
7/6/2004	0.003	0.001	0.018	0.002				
7/14/2004	0.002	0.001	0.020	0.002	<201		<201	
7/20/2004	0.002	0.001	0.022	0.002				
7/27/2004	0.004	0.001	0.030	0.002				
8/3/2004	0.001	0.001	0.008	0.001	219	90	<191	
8/10/2004	0.003	0.001	0.023	0.002				
8/10/2004	0.001	0.001	0.021	0.002				
8/17/2004	0.002	0.001	0.013	0.002				
8/24/2004	0.002	0.001	0.022	0.002				
8/31/2004	0.003	0.001	0.019	0.002	<193		<193	
9/8/2004	0.002	0.001	0.016	0.002				
9/15/2004	0.001	0.001	0.015	0.002				
9/21/2004	0.002	0.001	0.012	0.002				
9/28/2004	0.003	0.001	0.025	0.002	349	98	<198	
10/6/2004	0.007	0.001	0.041	0.002				
10/12/2004	0.004	0.001	0.031	0.002				
10/19/2004	0.004	0.001	0.024	0.002	362	94	<187	
10/26/2004	0.002	0.001	0.018	0.002				
11/3/2004	0.003	0.001	0.030	0.002				
11/9/2004	0.004	0.001	0.027	0.002				
11/17/2004	0.002	0.001	0.019	0.002	810	114	<198	
11/23/2004	0.004	0.001	0.029	0.002				
11/30/2004	0.002	0.001	0.016	0.002				
12/7/2004	0.005	0.001	0.031	0.002				
12/14/2004	0.002	0.001	0.020	0.002				
12/22/2004	0.004	0.001	0.022	0.002				
12/29/2004	0.002	0.001	0.022	0.002	782	111	<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Allendale, SC (ALN)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.004	0.001	0.021	0.002				
1/13/2004	0.007	0.001	0.029	0.002	<191		<191	
1/20/2004	0.006	0.001	0.031	0.002				
1/28/2004	0.005	0.001	0.025	0.002				
2/3/2004	0.003	0.001	0.025	0.002				
2/10/2004	0.003	0.001	0.024	0.002				
2/17/2004	0.003	0.001	0.021	0.002				
2/24/2004	0.003	0.001	0.022	0.002				
3/3/2004	0.002	0.001	0.021	0.002	<194		<194	
3/9/2004	0.004	0.001	0.023	0.002				
3/16/2004	0.003	0.001	0.024	0.002				
3/23/2004	0.004	0.001	0.021	0.002				
3/30/2004	0.003	0.001	0.018	0.002				
4/6/2004	0.002	0.001	0.017	0.002	192	85	<181	
4/13/2004	0.003	0.001	0.024	0.002				
4/20/2004	0.003	0.001	0.022	0.002				
4/27/2004	0.006	0.001	0.027	0.002				
5/4/2004	0.003	0.001	0.018	0.002	<186		<186	
5/11/2004	0.007	0.001	0.031	0.002				
5/18/2004	0.005	0.001	0.031	0.002				
5/25/2004	0.004	0.001	0.024	0.002				
6/1/2004	0.005	0.001	0.021	0.002	<196		<196	
6/8/2004	0.004	0.001	0.026	0.002				
6/15/2004	0.003	0.001	0.015	0.002				
6/22/2004	0.003	0.001	0.018	0.002	<188		<188	
6/29/2004	0.002	0.001	0.016	0.002				
7/6/2004	0.002	0.001	0.018	0.002				
7/14/2004	0.002	0.001	0.019	0.002	<201		<201	
7/20/2004	0.002	0.001	0.027	0.002				
7/27/2004	0.003	0.001	0.032	0.002				
8/3/2004	0.002	0.001	0.010	0.001	<191		<191	
8/10/2004	0.003	0.001	0.020	0.002				
8/17/2004	0.001	0.001	0.016	0.002				
8/24/2004	0.002	0.001	0.022	0.002				
8/31/2004	0.002	0.001	0.020	0.002	266	93	<193	
9/8/2004	0.002	0.001	0.016	0.002				
9/15/2004	0.001	0.001	0.016	0.002				
9/21/2004	0.002	0.001	0.014	0.002				
9/28/2004	0.003	0.001	0.028	0.002	<198		<198	
10/6/2004	0.007	0.001	0.038	0.002				
10/12/2004	0.004	0.001	0.035	0.002				
10/19/2004	0.003	0.001	0.027	0.002	229	89	<187	
10/26/2004	0.002	0.001	0.021	0.002				
11/3/2004	0.004	0.001	0.034	0.002				
11/9/2004	0.004	0.001	0.032	0.002				
11/17/2004	0.002	0.001	0.022	0.002	<198		<198	
11/23/2004	0.004	0.001	0.031	0.002				
11/30/2004	0.002	0.001	0.017	0.002				
12/7/2004	0.005	0.001	0.033	0.002				
12/14/2004	0.003	0.001	0.022	0.002				
12/22/2004	0.004	0.001	0.022	0.002				
12/29/2004	0.004	0.001	0.026	0.002	384	97	<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Snelling, SC (SCT)								
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.005	0.001	0.020	0.002				
1/13/2004	0.007	0.001	0.026	0.002	1073	121	217	90
1/20/2004	0.006	0.001	0.032	0.002				
1/28/2004	0.006	0.001	0.028	0.002				
2/3/2004	0.004	0.001	0.022	0.002				
2/10/2004	0.003	0.001	0.024	0.002				
2/17/2004	0.002	0.001	0.021	0.002				
2/24/2004	0.003	0.001	0.028	0.002				
3/3/2004	0.002	0.001	0.022	0.002	983	119	381	97
3/9/2004	0.004	0.001	0.024	0.002				
3/16/2004	0.003	0.001	0.021	0.002				
3/23/2004	0.004	0.001	0.021	0.002				
3/30/2004	0.002	0.001	0.016	0.002				
4/6/2004	0.002	0.001	0.017	0.002	660	104	252	87
4/13/2004	0.004	0.001	0.025	0.002				
4/20/2004	0.003	0.001	0.023	0.002				
4/27/2004	0.007	0.001	0.031	0.002				
5/4/2004	0.004	0.001	0.016	0.002	349	94	277	91
5/11/2004	0.006	0.001	0.031	0.002				
5/18/2004	0.005	0.001	0.028	0.002				
5/25/2004	0.004	0.001	0.023	0.002				
6/1/2004	0.004	0.001	0.020	0.002	368	97	<196	
6/8/2004	0.004	0.001	0.021	0.002				
6/15/2004	0.003	0.001	0.014	0.002				
6/22/2004	0.003	0.001	0.018	0.002	335	93	<188	
6/29/2004	0.002	0.001	0.013	0.002				
7/6/2004	0.004	0.001	0.020	0.002				
7/14/2004	0.002	0.001	0.021	0.002	675	110	<201	
7/20/2001	0.003	0.001	0.023	0.002				
7/27/2004	0.004	0.001	0.032	0.002				
8/3/2004	0.002	0.001	0.011	0.001	706	108	<191	
8/10/2004	0.003	0.001	0.022	0.002				
8/17/2004	0.001	0.001	0.015	0.002				
8/24/2004	0.002	0.001	0.023	0.002				
8/31/2004	0.002	0.001	0.021	0.002	647	107	<193	
9/8/2004	0.002	0.001	0.017	0.002				
9/15/2004	0.001	0.001	0.016	0.002				
9/21/2004	0.002	0.001	0.013	0.002				
9/28/2004	0.002	0.001	0.026	0.002	<198		<198	
10/6/2004	0.008	0.001	0.045	0.002				
10/12/2004	0.006	0.001	0.035	0.002				
10/19/2004	0.003	0.001	0.026	0.002	534	101	<187	
10/26/2004	0.002	0.001	0.020	0.002				
11/3/2004	0.003	0.001	0.033	0.002				
11/9/2004	0.004	0.001	0.030	0.002				
11/17/2004	0.002	0.001	0.023	0.002	<198		<198	
11/23/2004	0.003	0.001	0.026	0.002				
11/30/2004	0.001	0.001	0.016	0.002				
12/7/2004	0.005	0.001	0.032	0.002				
12/14/2004	0.003	0.001	0.020	0.002				
12/22/2004	0.004	0.001	0.022	0.002				
12/29/2004	0.003	0.001	0.019	0.002	642	109	<191	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Burial Ground North (SRS)								
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	NS	NA	NS	NA				
1/13/2004	NS	NA	NS	NA	NS	NA	NS	NA
1/20/2004	NS	NA	NS	NA				
1/28/2004	NS	NA	NS	NA				
2/3/2004	NS	NA	NS	NA				
2/10/2004	NS	NA	NS	NA				
2/17/2004	NS	NA	NS	NA				
2/24/2004	NS	NA	NS	NA				
3/3/2004	NS	NA	NS	NA	NS	NA	NS	NA
3/9/2004	0.003	0.001	0.021	0.002				
3/16/2004	0.002	0.001	0.022	0.002				
3/23/2004	0.003	0.001	0.021	0.002				
3/30/2004	0.002	0.001	0.019	0.002				
4/6/2004	0.002	0.001	0.016	0.002	17107	367	NS	NA
4/13/2004	0.003	0.001	0.024	0.002				
4/20/2004	0.003	0.001	0.022	0.002				
4/27/2004	0.004	0.001	0.027	0.002				
5/4/2004	0.003	0.001	0.017	0.002	11624	308	NS	NA
5/11/2004	0.006	0.001	0.028	0.002				
5/18/2004	0.005	0.001	0.030	0.002				
5/25/2004	0.005	0.001	0.024	0.002				
6/1/2004	0.005	0.001	0.019	0.002	9800	285	NS	NA
6/8/2004	0.003	0.001	0.022	0.002				
6/15/2004	0.003	0.001	0.013	0.002				
6/22/2004	0.004	0.001	0.034	0.002	9942	286	NS	NA
6/29/2004	0.001	0.001	0.014	0.002				
7/6/2004	0.003	0.001	0.019	0.002				
7/14/2004	0.002	0.001	0.020	0.002	6246	233	NS	NA
7/20/2004	0.002	0.001	0.024	0.002				
7/27/2004	0.003	0.001	0.033	0.002				
8/3/2004	0.001	0.001	0.010	0.001	13675	333	NS	NA
8/10/2004	0.003	0.001	0.023	0.002				
8/17/2004	0.002	0.001	0.015	0.002				
8/24/2004	0.002	0.001	0.023	0.002				
8/31/2001	0.002	0.001	0.020	0.002	14245	340	NS	NA
9/8/2004	0.002	0.001	0.016	0.001				
9/15/2004	0.001	0.001	0.017	0.002				
9/21/2004	0.002	0.001	0.013	0.002				
9/28/2004	0.003	0.001	0.028	0.002	7751	258	NS	NA
10/6/2004	0.008	0.001	0.044	0.002				
10/12/2004	0.006	0.001	0.037	0.002				
10/19/2004	0.004	0.001	0.027	0.002	10159	289	NS	NA
10/26/2004	0.002	0.001	0.020	0.002				
11/3/2004	0.003	0.001	0.034	0.002				
11/9/2004	0.005	0.001	0.033	0.002				
11/17/2004	0.003	0.001	0.023	0.002	13583	334	NS	NA
11/23/2004	0.003	0.001	0.029	0.002				
12/1/2004	0.002	0.001	0.018	0.002				
12/7/2004	0.006	0.001	0.039	0.003				
12/14/2004	0.003	0.001	0.021	0.002				
12/22/2004	0.004	0.001	0.020	0.002				
12/29/2004	0.003	0.001	0.029	0.002	23267	431	NS	NA

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

Sample Location: Williston, SC (WIL)								
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m3	+- 2 sigma	pCi/m3	+- 2 sigma	pCi/m3	+- 2 sigma	pCi/L	+- 2 sigma
1/7/2004	0.004	0.001	0.020	0.002				
1/13/2004	0.005	0.001	0.028	0.002	745	110	312	94
1/20/2004	0.005	0.001	0.030	0.002				
1/28/2004	0.005	0.001	0.033	0.002				
2/3/2004	0.004	0.001	0.024	0.002				
2/10/2004	0.003	0.001	0.024	0.002				
2/17/2004	0.002	0.001	0.022	0.002				
2/24/2004	0.003	0.001	0.028	0.002				
3/3/2004	0.002	0.001	0.022	0.002	1121	123	<194	
3/9/2004	0.003	0.001	0.024	0.002				
3/16/2004	0.004	0.003	0.029	0.006				
3/23/2004	0.003	0.001	0.021	0.002				
3/30/2004	0.003	0.001	0.018	0.002				
4/6/2004	0.002	0.001	0.016	0.002	391	93	228	86
4/13/2004	0.003	0.001	0.023	0.002				
4/20/2004	0.002	0.001	0.022	0.002				
4/27/2004	0.007	0.001	0.029	0.002				
5/4/2004	0.003	0.001	0.017	0.002	1107	120	474	98
5/11/2004	0.006	0.001	0.030	0.002				
5/18/2004	0.005	0.001	0.033	0.002				
5/25/2004	0.004	0.001	0.019	0.002				
6/1/2004	0.006	0.001	0.020	0.002	<196		285	94
6/8/2004	0.003	0.001	0.020	0.002				
6/15/2004	0.004	0.001	0.016	0.002				
6/22/2004	0.002	0.001	0.017	0.002	<188		<188	
6/29/2004	0.002	0.001	0.014	0.002				
7/6/2004	0.002	0.001	0.018	0.002				
7/14/2004	0.002	0.001	0.020	0.002	<201		<210	
7/20/2004	0.003	0.001	0.023	0.002				
7/27/2004	0.003	0.001	0.033	0.003				
8/3/2004	<MDA		0.005	0.001	510	101	537	102
8/10/2004	0.003	0.001	0.023	0.002				
8/17/2004	0.001	0.002	0.023	0.004				
8/24/2004	0.003	0.001	0.023	0.002				
8/31/2004	0.002	0.001	0.021	0.002	452	100	<193	
9/8/2004	0.002	0.001	0.018	0.002				
9/15/2004	0.001	0.001	0.016	0.002				
9/21/2004	0.001	0.001	0.013	0.002				
9/28/2004	0.003	0.001	0.026	0.002	496	103	<198	
10/6/2004	0.006	0.001	0.037	0.002				
10/12/2004	0.005	0.001	0.037	0.002				
10/19/2004	0.005	0.001	0.028	0.002	549	102	<187	
10/26/2004	0.002	0.001	0.022	0.002				
11/3/2004	0.003	0.001	0.033	0.002				
11/9/2004	0.004	0.001	0.031	0.023				
11/17/2004	0.003	0.001	0.020	0.002	306	96	404	100
11/23/2004	0.004	0.001	0.025	0.002				
11/30/2004	0.001	0.001	0.017	0.002				
12/7/2004	0.006	0.001	0.032	0.002				
12/14/2004	0.002	0.002	0.018	0.003				
12/22/2004	0.005	0.001	0.022	0.002				
12/29/2004	0.003	0.001	0.023	0.002	500	102	<191	

Radiological Atmospheric Monitoring
Quarterly Atmospheric Ambient Beta/Gamma Data

Sample Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
	mrem	mrem	mrem	mrem	mrem
Colocated with Aiken Air Station	24.00	20.00	28.00	25.00	97.00
E-Area	44.00	34.00	35.00	37.00	150.00
Green Pond	29.00	25.00	28.00	28.00	110.00
Colocated with Jackson Air Station	27.00	22.00	26.00	28.00	103.00
Crackerneck Gate	35.00	27.00	34.00	32.00	128.00
TNX Boat Ramp	34.00	30.00	32.00	32.00	128.00
Colocated with Allendale Barricade	26.00	20.00	24.00	25.00	95.00
Junction of Millet Road and Round Tree Road	32.00	26.00	30.00	32.00	120.00
Patterson Mill Road At Lower Three Runs Creek	31.00	26.00	31.00	30.00	118.00
Colocated with Allendale Air station	30.00	23.00	26.00	27.00	106.00
Barnwell Airport	32.00	26.00	30.00	29.00	117.00
Colocated with Snelling Air station	31.00	24.00	29.00	28.00	112.00
Colocated with Williston Air station	29.00	24.00	26.00	27.00	106.00
Bates Cemetery	24.00	21.00	26.00	26.00	97.00
Williston Police Department	32.00	26.00	29.00	30.00	117.00
Junction of US 278 and SC 781	29.00	24.00	28.00	29.00	110.00
US 278 near Upper Three Runs Creek	35.00	29.00	32.00	34.00	130.00
Colocated with New Ellenton Air Station	29.00	21.00	26.00	29.00	105.00
Windsor Post Office	29.00	23.00	28.00	29.00	109.00

1.1.5 Summary Statistics
Radiological Atmospheric Monitoring

Statistical Review Of Radiological Monitoring at Aiken Elementary Water Tower (AIK)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in Rain
Mean	0.003	0.023	3.73	227
Std Dev	0.001	0.011	1.87	N/A
Median	0.003	0.021	2.93	227
Min	0.001	0.013	2.21	227
Max	0.007	0.093	8.18	227

Statistical Review Of Radiological Monitoring at New Ellenton, SC (NEL)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.024	5.8	326
Std Dev	0.001	0.011	1.9	163
Median	0.003	0.021	5.1	280
Min	0.001	0.008	3.5	194
Max	0.007	0.088	9.5	551

Statistical Review Of Radiological Monitoring at Jackson, SC (JAK)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.022	7.5	305
Std Dev	0.001	0.006	4.8	85
Median	0.003	0.021	6.6	281
Min	0.001	0.008	2.3	213
Max	0.006	0.039	16.7	482

Statistical Review Of Radiological Monitoring at Allendale Barricade (ABR)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.022	4.9	247
Std Dev	0.001	0.006	2.8	69
Median	0.003	0.021	4.0	247
Min	0.001	0.008	2.2	198
Max	0.007	0.041	9.3	295

Summary Statistics
Radiological Atmospheric Monitoring

Statistical Review Of Radiological Monitoring at Allendale, SC (ALN)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	3.08	<MDA
Std Dev	0.001	0.006	0.96	N/A
Median	0.003	0.022	2.85	<MDA
Min	0.001	0.010	2.21	<MDA
Max	0.007	0.038	4.42	<MDA

Statistical Review Of Radiological Monitoring at Snelling, SC (SCT)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	7.3	282
Std Dev	0.002	0.006	2.8	71
Median	0.003	0.022	7.4	265
Min	0.001	0.011	3.9	217
Max	0.008	0.045	12.3	381

Statistical Review Of Radiological Monitoring at Williston, SC (WIL)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	7.1	373
Std Dev	0.001	0.006	3.3	119
Median	0.003	0.023	5.8	358
Min	0.001	0.005	3.5	228
Max	0.007	0.037	12.9	537

Statistical Review of Radiological monitoring at Burial Grounds North, SRS (BGN)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	143.6	NA
Std Dev	0.001	0.007	54.5	NA
Median	0.003	0.022	133.7	NA
Min	0.001	0.010	71.8	NA
Max	0.008	0.044	267.6	NA

Summary Statistics
Radiological Atmospheric Monitoring
Ambient TLD Beta/Gamma

Sample Location	Yearly Avg	Std Dev	Min	Max
	mrem	mrem	mrem	mrem
Colocated with Aiken Air Station	24.25	3.30	20.00	28.00
E-Area	37.50	4.51	34.00	44.00
Green Pond	27.50	1.73	25.00	29.00
Colocated with Jackson Air Station	25.75	2.63	22.00	28.00
Crackerneck Gate	32.00	3.56	27.00	35.00
TNX Boat Ramp	32.00	1.63	30.00	34.00
Colocated with Allendale Barricade	23.75	2.63	20.00	26.00
Junction of Millet Road and Round Tree Road	30.00	2.83	26.00	32.00
Patterson Mill Road At Lower Three Runs Creek	29.50	2.38	26.00	31.00
Colocated with Allendale Air station	26.50	2.89	23.00	30.00
Barnwell Airport	29.25	2.50	26.00	32.00
Colocated with Snelling Air station	28.00	2.94	24.00	31.00
Colocated with Williston Air station	26.50	2.08	24.00	29.00
Bates Cemetery	24.25	2.36	21.00	26.00
Williston Police Department	29.25	2.50	26.00	32.00
Junction of US 278 and SC 781	27.50	2.38	24.00	29.00
US 278 near Upper Three Runs Creek	32.50	2.65	29.00	35.00
Colocated with New Ellenton Air Station	26.25	3.77	21.00	29.00
Windsor Post Office	27.25	2.87	23.00	29.00

2.1 Ambient Groundwater Quality Adjacent to SRS

2.1.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) samples an ambient groundwater quality monitoring network ("network") adjacent to Savannah River Site (SRS). The network is comprised of existing groundwater wells owned by various government agencies, businesses, and members of the public. ESOP is providing 2004 project data to the public as an independent source of information regarding SRS activities and the potential impacts of those activities on public health and the environment.

The ESOP Ambient Groundwater Monitoring Project (AGMP) evaluates ambient groundwater quality adjacent to SRS to develop offsite water quality information and determine if contaminants have migrated off SRS. The study area includes SRS and a 10-mile perimeter from the SRS boundary in South Carolina (Map 3, section 2.1.2). ESOP evaluates five aquifer zones within the study area, from the shallow water table to confined aquifers more than 1200 feet deep. ESOP samples different portions of the network on a five-year cycle. In 2004, ESOP sampled 21 wells from the southeastern portion of the study area. ESOP analyzed filtered and non-filtered groundwater for basic water quality parameters, metals, tritium, and alpha-emitting, beta-emitting, and gamma-emitting radioisotopes.

This report will continue to be rendered to the public on an annual basis as an independent source of regional groundwater information associated with historical ESOP and SRS data. ESOP will continue to evaluate historical ESOP and SRS data to provide the public with an independent source of regional groundwater information.

RESULTS AND DISCUSSION

Very few technical difficulties were encountered within the Ambient Groundwater Monitoring Network (AGMN). In particular, some field measurements were not obtained due to meter failure; however, a minimum of three (3) well volumes was purged prior to collecting samples.

Based on a review of the analytical data, various contaminants were detected in 21 wells sampled. Two of the 21 wells contained contaminants (Table 1, section 2.1.3) in excess of the United States Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCL) of 4 millirem per year (mrems/yr) or 8 picocuries per liter (pCi/L) for gross non-volatile beta.

As the Department of Energy-Savannah River (DOE-SR) collects groundwater samples from a different monitoring well network, direct comparisons could not be made to the findings (i.e., detectable levels of tritium and some chlorinated solvents) in the latest DOE-SR report (WSRC 2005). However, the 2004 AGMP and associated statistical results acquired from perimeter and background sampling locations tend to support DOE-SR findings that radiological and nonradiological contaminants associated with SRS activities have not migrated off the SRS via the groundwater route. Analytical results are summarized in section 2.1.4.

Metals

The presence of metals in the environment can be attributed to man-made processes and/or the natural decay of deposits. With the exception of lead, a review of the following metal contaminants detected indicates that their presence is most likely due to the erosion of natural deposits.

Barium was detected at concentrations of 0.19 milligrams per liter (mg/L), 0.093 mg/L, 0.085 mg/L, 0.1 mg/L, 0.13 mg/L, 0.11 mg/L, 0.11 mg/L, 0.23 mg/L, 0.13 mg/L, 0.11 mg/L, and 0.061 mg/L in wells M03704, M03705, M03706, M03707, M03708, M03709, M03131, M03132, M06605, M06608, and M03103 respectively. The MCL for barium is 2 mg/L. Based upon the hydraulically cross-gradient distance of these wells from SRS process areas K, L, and P, it is unlikely that this contaminant is related to SRS activities.

Cadmium was detected at a concentration of 0.00016 mg/L in well M03104. The MCL for cadmium is 0.005 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of M03104 from SRS process areas K, L, and P, it is unlikely that this contaminant is related to SRS activities.

Chromium was detected at concentrations of 0.014 mg/L and 0.019 mg/L in wells M03709 and M03104 respectively. The MCL for chromium is 0.1 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of these wells from SRS process areas K, L, and P, it is unlikely that this contaminant is related to SRS activities.

Copper was detected at a concentration of 0.016 mg/L in well M03709. The MCL for copper is 1.3 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of M03709 from SRS process areas K, L, and P, it is unlikely that this contaminant is related to SRS activities.

Lead was detected at a concentration of 0.0093 mg/L in well M03701. The MCL for lead is 0.015 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of M03701 from SRS process areas K, L, and P, it is unlikely that this contaminant is related to SRS activities. The lead concentration in this well is probably due to the corrosion of well construction material or formation chemistry interactions.

Anions

Fluoride was detected at concentrations of 0.1 mg/L, 0.11 mg/L, 0.13 mg/L, 0.12 mg/L, 0.12 mg/L, and 0.12 mg/L in wells M03705, M03708, M03131, M06603, M06604, and M03104 respectively. The MCL for fluoride is 4 mg/L. The presence of fluoride is most likely due to the erosion of natural deposits.

Nitrate was detected at concentrations well below the 10 mg/L MCL in 11 monitoring wells (section 2.1.4). The presence of nitrate is most likely due to the erosion of natural deposits and/or runoff from fertilizer use. Once in the soil, nitrate is very mobile due to its water solubility trait and therefore moves easily through the soil matrix at a speed comparable to water.

Radionuclides

Gross alpha was detected at concentrations below the 15 pCi/L MCL in all 20 monitoring wells that were analyzed (section 2.1.4). As the presence of naturally occurring radionuclides has been well documented in the groundwater regime across the state, the concentrations of gross alpha are probably due to the natural decay process of uranium deposits within the subsurface. In addition, a statistical analysis indicates that the gross alpha concentrations within 50 miles of SRS and in excess of 50 miles (background) are comparable (Figure 1, section 2.1.5).

Gross non-volatile beta was detected in all 20 monitoring wells that were analyzed (section 2.1.4.). Two of those wells contained concentrations in excess of the 4 mrem/yr or 8 pCi/L MCL. Concentrations of 8.39 pCi/L and 8.66 pCi/L were detected in M03708 and M03102 respectively. A portion of the concentration detected in M03708 is attributable to the beta-emitting particle radium-228 since the activity for this radioisotope was detected at 0.905 pCi/L (see below). The concentration detected in M03102 remains above the MCL even if the concentration of radium-228 (0.527 pCi/L) is deducted from the total concentration.

Radium-226 was detected at a concentration of 1.13 pCi/L in monitoring well M03706 (section 2.1.4.). Various combinations of uranium, radium-226, and radium-228 were detected at concentrations < 1.0 pCi/L in all 20 monitoring wells that were analyzed. As the presence of naturally occurring radionuclides (i.e., uranium, radium-226/228) has been well documented in the groundwater regime across the state, the concentrations of uranium, radium-226, and radium-228 are probably due to the natural decay process of uranium deposits within the subsurface. In addition, a statistical analysis indicates that the ra-228 concentrations within 50 miles of SRS and in excess of 50 miles are comparable (Figure 2, section 2.1.5). This information will be shared with other ESOP programs for tracking and public awareness purposes.

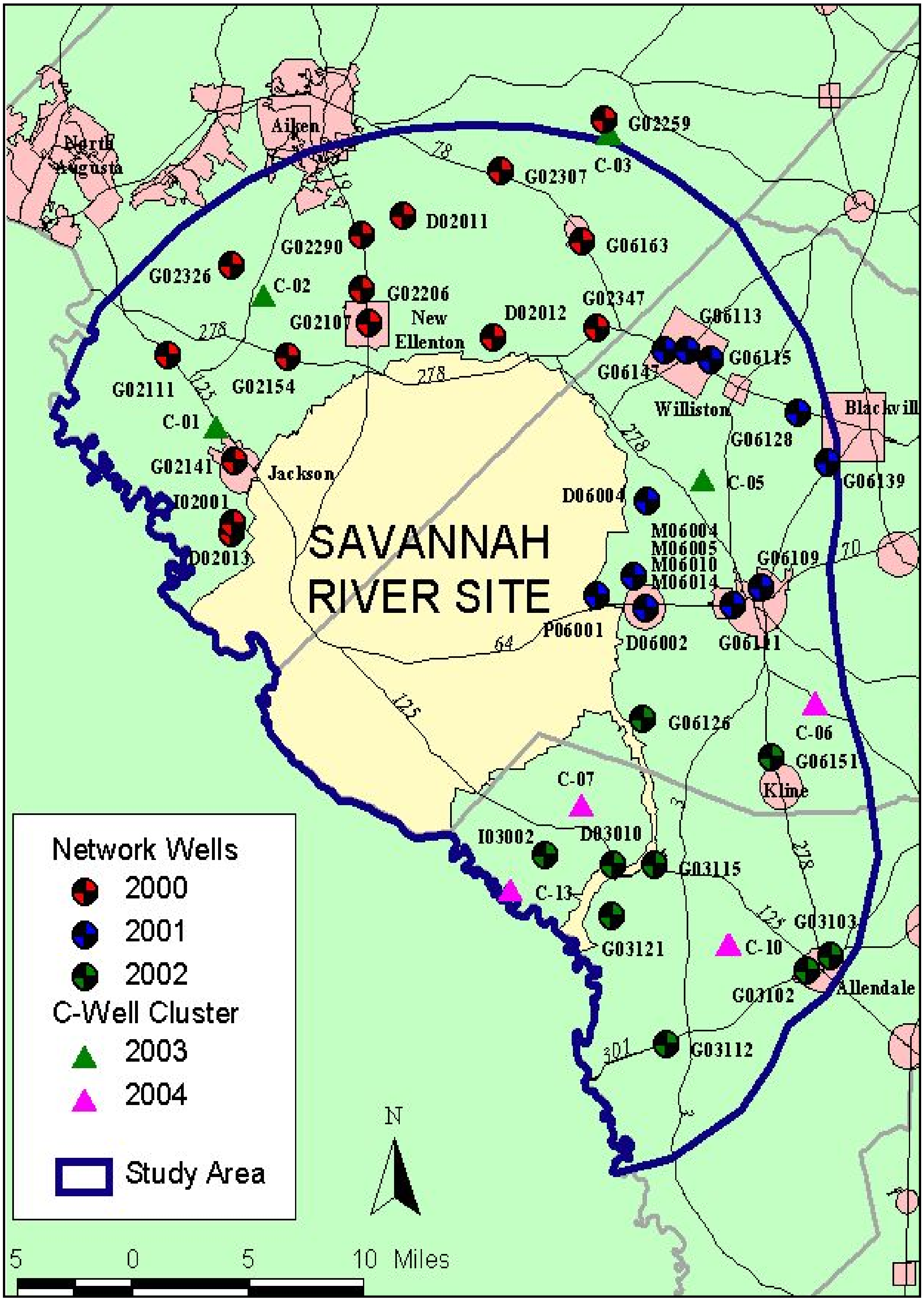
CONCLUSIONS AND RECOMMENDATIONS

A review of the analytical data revealed various nonradiological constituents in all 21 wells sampled and various radiological constituents present in all 20 wells sampled. Two of the wells contained contaminants in excess of the EPA MCL for gross non-volatile beta and will be resampled for speciation purposes. M03101 was inadvertently not sampled for radiological constituents (with the exception of tritium) and will be resampled.

The AGMP attempted to determine if constituents, other than naturally occurring, have impacted the groundwater regime within the AGMN. The results indicate that several non-radiological constituents and naturally occurring radioisotopes are impacting groundwater quality.

Independent monitoring of basic water quality parameters, metals, tritium, gross alpha, non-volatile beta, and gamma-emitting radioisotopes will continue along with the conducting of a statistical analysis of perimeter and background data in addition to the evaluating of DOE-SR groundwater monitoring data. Continued monitoring will provide a better understanding of actual groundwater quality parameter levels, their extent, and trends. Several important benefits can be realized as a result: (a) the ability to compare most recent data with historical data and (b) for ESOP Bureau of Water to further evaluate the extent of naturally occurring radioisotopes in the region.

2.1.2
Map 3. Ambient Groundwater Network



2.1.3 Tables and Figures
Ambient Groundwater Monitoring

Table 1. Summary of Contaminants Detected Above an Established MCL in 2004

Well No.	Well Name	Analyte	MCL	Concentration	Aquifer
M03708	SCDNR Cluster C-07, ALL-370	Gross Beta	4 mrem/yr or 8 pCi/L	8.39 pCi/L	MB
M03102	SCDNR Cluster C-10, ALL-372	Gross Beta	4 mrem/yr or 8 pCi/L	8.66 pCi/L	UTR

2.1.4 Data

Ambient Groundwater Data

Ambient Groundwater Data

	Well Number:		M03702		M03703		M03704	
	Sample Date:		04/19/04		04/19/04		04/20/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	20.6	NA	21.1	NA	21	NA
	pH	(S.U.)	6.35	NA	7.21	NA	2.41	NA
	Conductivity	(mS/cm)	0.152	NA	0.209	NA	0.214	NA
	Dissolved Oxygen	(mg/L)	x	NA	x	NA	x	NA
	Turbidity	(NTU)	1	NA	1	NA	1	NA
	Background Radiation	(uR/hr)	12.14	NA	12.14	NA	10.52	NA
	Sample Radiation	(uR/hr)	10.52	NA	11.3	NA	10.52	NA
Chemistry	Alkalinity	(mg/L)	85	84	110	110	110	110
	Pth. Alkalinity	(mg/L)	0	0	0	0	0	0
	Hardness (calculated)	(mg/L)	98	86	110	110	120	120
	pH, Lab	(S.U.)	7.9	7.9	8	8	7.8	7.8
	Specific Conductance (@25C)	(umhos/cm)	172	172	237	239	236	237
	Total Dissolved Solids	(mg/L)	100	100	150	140	140	140
	Total Organic Carbon	(mg/L)	2.2	<2.0	2.1	2.7	<2.0	2.7
	Bromide	(mg/L)	<0.020	<0.020	<0.020	<0.020	0.026	<0.020
	Chloride	(mg/L)	2.1	2	2.9	3	2.5	2.4
	Fluoride	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	0.056	0.056	<0.020	<0.020	<0.020	*
	Nitrate	(mg/L)	0.056	0.056	<0.020	<0.020	<0.020	*
	Ammonia	(mg/L)	0.098	0.085	0.11	0.12	0.1	*
	Total Kjeldahl Nitrogen	(mg/L)	0.13	<0.10	0.18	0.11	<0.10	*
	Phosphate, Ortho.	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Sulfate	(mg/L)	<5.0	<5.0	9.6	9.7	10	8.9
Metals	Aluminum	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	<0.050	<0.050	<0.050	<0.050	0.19	0.19
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.010	<0.10
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Calcium	(mg/L)	32	33	39	40	41	41
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Iron	(mg/L)	<0.020	<0.020	0.068	0.07	0.16	0.16
	Lead	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	4.5	1	2.9	2.9	3.1	3.1
	Manganese	(mg/L)	<0.010	<0.010	0.021	0.022	0.03	0.03
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	<1.0	<1.0	2.6	2.5	2.2	2.2
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	5.8	6.2	9.3	9.4	11	11
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.4	1.4	2.3	2	1.9	1.9
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	0.21	0.081	0.1	0.028	0.098	0.032

Ambient Groundwater Data

	Well Number:		M03702		M03703		M03704	
	Sample Date:		04/19/04		04/19/04		04/20/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<190	NA	<190	NA	<190	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	1.16E+00	NA	1.75E+00	NA	8.42E-01	NA
	±2	(sigma)	1.60E+00		1.90E+00		1.90E+00	
	MDA	(pCi/L)	1.10E+00		1.40E+00		1.50E+00	
	Gross Non-volatile Beta	(pCi/L)	8.83E-01	NA	3.55E+00	NA	2.48E+00	NA
	±2	(sigma)	6.30E-01		8.00E-01		7.70E-01	
	MDA	(pCi/L)	8.80E-01		8.70E-01		9.20E-01	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	1.80E+02		1.90E+02		9.90E+01	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.60E+01		1.90E+00		1.70E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.20E+00		2.20E+00		1.30E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.60E+02		3.80E+02		1.80E+02	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	5.96E+00	NA
	±2	(sigma)					1.00E+01	
	MDA	(pCi/L)	2.20E+01		2.00E+01			
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.30E+02		4.60E+02		3.80E+01	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	5.20E+01		5.50E+01		2.50E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.30E+01		1.40E+01		8.30E+00	

Ambient Groundwater Data

	Well Number:		M03705		M03706		M03707	
	Sample Date:		04/21/04		04/21/04		04/22/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	x	NA	x	NA	22	NA
	pH	(S.U.)	x	NA	x	NA	5.84	NA
	Conductivity	(mS/cm)	x	NA	x	NA	0.114	NA
	Dissolved Oxygen	(mg/L)	x	NA	x	NA	0.9	NA
	Turbidity	(NTU)	x	NA	x	NA	0	NA
	Background Radiation	(uR/hr)	10.52	NA	8.9	NA	10.52	NA
	Sample Radiation	(uR/hr)	NA	NA	NA	NA	15.37	NA
Chemistry	Alkalinity	(mg/L)	36	36	33	33	39	38
	Pth. Alkalinity	(mg/L)	0	0	0	0	0	0
	Hardness (calculated)	(mg/L)	39	36	36	36	34	37
	pH, Lab	(S.U.)	6.6	6.6	6.5	6.5	6.5	6.6
	Specific Conductance (@25C)	(umhos/cm)	106	106	97.4	98	108	107
	Total Dissolved Solids	(mg/L)	64	56	54	50	90	84
	Total Organic Carbon	(mg/L)	3	3.8	3.3	2.9	<2.0	<2.0
	Bromide	(mg/L)	<0.020	0.024	<0.020	<0.020	<0.020	<0.020
	Chloride	(mg/L)	2.4	2.2	2.2	2.2	2.3	2.2
	Fluoride	(mg/L)	<0.10	0.1	<0.10	<0.10	<0.10	<0.10
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	0.031	0.024
	Nitrate	(mg/L)	<0.020	<0.020	<0.020	<0.020	0.031	0.024
	Ammonia	(mg/L)	0.089	0.09	0.087	0.094	0.067	0.085
	Total Kjeldahl Nitrogen	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Phosphate, Ortho.	(mg/L)	0.098	0.10	0.14	0.14	0.17	0.18
	Sulfate	(mg/L)	10	11	9.4	11	8.6	9.6
Metals	Aluminum	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	0.093	0.089	0.085	0.085	0.098	0.1
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Calcium	(mg/L)	14	13	13	12	11	12
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Iron	(mg/L)	0.69	0.63	0.58	0.56	0.31	0.32
	Lead	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	1.0	0.97	0.99	1	1.5	1.6
	Manganese	(mg/L)	0.03	0.029	0.028	0.027	0.021	0.021
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	2.7	2.7	2.5	2.4	4	4
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	6.5	6.2	5.9	5.9	6.4	6.7
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.8	1.6	1.6	1.5	2.1	1.5
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	2.6	2	2	1.6	2.2	2.1

Ambient Groundwater Data

	Well Number:		M03705		M03706		M03707	
	Sample Date:		04/21/04		04/21/04		04/22/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<187	NA	<190	NA	<190	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	2.70E+00	NA	1.94E+00	NA	1.94E+00	NA
	±2	(sigma)	1.70E+00		1.60E+00		1.80E+00	
	MDA	(pCi/L)	1.20E+00		1.10E+00		1.50E+00	
	Gross Non-volatile Beta	(pCi/L)	3.03E+00	NA	2.91E+00	NA	4.48E+00	NA
	±2	(sigma)	7.80E-01		7.40E-01		8.70E-01	
	MDA	(pCi/L)	9.00E-01		8.40E-01		9.10E-01	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	1.40E+02		1.90E+02		1.60E+02	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.60E+00		1.90E+00		2.10E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.30E+00		2.30E+00		2.20E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.20E+02		3.50E+02		3.30E+02	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.60E+01		2.30E+01		1.90E+01	
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.70E+01		4.80E+02		4.80E+02	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.60E+01		5.40E+01		5.60E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.60E+00		1.20E+01		1.20E+01	

Ambient Groundwater Data

	Well Number:		Blind Dup-01		M03708		M03709	
	Sample Date:		04/22/04		05/04/04		05/05/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	NA	NA	22.9	NA	22.8	NA
	pH	(S.U.)	NA	NA	6.61	NA	6.14	NA
	Conductivity	(mS/cm)	NA	NA	0.103	NA	0.088	NA
	Dissolved Oxygen	(mg/L)	NA	NA	NA	NA	8.92	NA
	Turbidity	(NTU)	NA	NA	0	NA	NA	NA
	Background Radiation	(uR/hr)	NA	NA	13.75	NA	17.8	NA
	Sample Radiation	(uR/hr)	NA	NA	10.52	NA	16.99	NA
Chemistry	Alkalinity	(mg/L)	38	39	33	34	18	18
	Pth. Alkalinity	(mg/L)	0	0	0	0	0	0
	Hardness (calculated)	(mg/L)	37	34	27	26	9	7.9
	pH, Lab	(S.U.)	6.5	6.6	7	7	6.6	6.7
	Specific Conductance (@25C)	(umhos/cm)	108	108	110	110	81.5	82.6
	Total Dissolved Solids	(mg/L)	82	84	68	64	50	50
	Total Organic Carbon	(mg/L)	2.1	<2.0	<2.0	2.1	<2.0	<2.0
	Bromide	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride	(mg/L)	2.3	2.3	1.7	1.7	1.8	1.7
	Fluoride	(mg/L)	<0.10	0.1	0.1	0.11	<0.10	<0.10
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	0.023	0.026	<0.020	<0.020	0.021	<0.020
	Nitrate	(mg/L)	0.023	0.026	<0.020	<0.020	0.021	<0.020
	Ammonia	(mg/L)	0.096	0.09	0.079	0.075	0.076	0.083
	Total Kjeldahl Nitrogen	(mg/L)	0.12	0.12	0.13	<0.10	0.21	0.23
	Phosphate, Ortho.	(mg/L)	0.18	0.18	0.099	0.1	0.06	0.055
	Sulfate	(mg/L)	9.2	9.2	14	15	14	12
Metals	Aluminum	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	0.1	0.098	0.13	0.13	0.11	0.095
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.011	0.011
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Calcium	(mg/L)	12	11	7.5	7.5	2.6	2.3
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	0.013	0.014
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	0.011	0.016
	Iron	(mg/L)	0.33	0.32	0.47	0.46	0.72	0.61
	Lead	(mg/L)	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	1.6	1.5	1.9	1.8	0.60	0.52
	Manganese	(mg/L)	0.022	0.029	0.037	0.037	0.042	0.037
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	4	3.8	6.3	6.3	4.6	4
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	6.8	6.5	6	6	3.8	3.4
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.5	1.5	2.8	2.8	4.5	2.8
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	2.2	2.1	1.5	1.1	3.5	2.9

Ambient Groundwater Data

	Well Number:		Blind Dup-01		M03708		M03709	
	Sample Date:		04/22/04		05/04/04		05/05/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<190	NA	<190	NA	<190	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	2.47E+00	NA	2.07E+00	NA	1.02E+00	NA
	±2	(sigma)	1.50E+00		1.70E+00		1.30E+00	
	MDA	(pCi/L)	9.70E-01		1.20E+00		9.00E-01	
	Gross Non-volatile Beta	(pCi/L)	4.49E+00	NA	8.39E+00	NA	5.98E+00	NA
	±2	(sigma)	8.40E-01		1.10E+00		9.20E-01	
	MDA	(pCi/L)	8.80E-01		8.80E-01		8.60E-01	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	2.10E+02		8.70E+01		4.30E+01	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.70E+00		2.00E+00		1.60E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.40E+00		2.10E+00		1.30E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.90E+02		1.20E+00		5.20E+01	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.70E+01		2.10E+01		1.40E+01	
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.90E+02		4.90E+02		3.70E+01	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	6.10E+01		5.50E+01		2.60E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.40E+01		1.20E+01		9.60E+00	

Ambient Groundwater Data

	Well Number:		M03131		M03132		M03701	
	Sample Date:		05/06/04		05/06/04		05/11/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	#	@	#	@	x	NA
	pH	(S.U.)	#	@	#	@	x	NA
	Conductivity	(mS/cm)	#	@	#	@	x	NA
	Dissolved Oxygen	(mg/L)	#	@	#	@	x	NA
	Turbidity	(NTU)	#	@	#	@	x	NA
	Background Radiation	(uR/hr)	7.28	@	NA	@	11.33	NA
	Sample Radiation	(uR/hr)	4.85	@	NA	@	16.18	NA
Chemistry	Alkalinity	(mg/L)	99	@	45	@	5.1	4.3
	Pth. Alkalinity	(mg/L)	0	@	<1.0	@	0	0
	Hardness (calculated)	(mg/L)	100	@	7.8	@	4.4	3.7
	pH, Lab	(S.U.)	8.0	@	8.6	@	6.2	6.2
	Specific Conductance (@25C)	(umhos/cm)	235	@	123	@	28.2	28.2
	Total Dissolved Solids	(mg/L)	150	@	76	@	22	28
	Total Organic Carbon	(mg/L)	<2.0	@	<2.0	@	<2.0	<2.0
	Bromide	(mg/L)	<0.020	@	<0.020	@	<0.020	<0.020
	Chloride	(mg/L)	2.3	@	1.6	@	2.6	2
	Fluoride	(mg/L)	0.13	@	<0.10	@	<0.10	<0.10
	Nitrite	(mg/L)	<0.020	@	<0.020	@	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	0.026	@	0.02	@	0.58	0.71
	Nitrate	(mg/L)	0.026	@	0.02	@	0.58	0.71
	Ammonia	(mg/L)	*	@	*	@	*	0.075
	Total Kjeldahl Nitrogen	(mg/L)	*	@	*	@	*	0.2
	Phosphate, Ortho.	(mg/L)	<0.020	@	0.026	@	<0.020	<0.020
	Sulfate	(mg/L)	12	@	11	@	<5	<5
Metals	Aluminum	(mg/L)	<0.10	@	<0.10	@	<0.10	<0.10
	Antimony	(mg/L)	<0.0030	@	<0.0030	@	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	@	<0.0050	@	<0.0050	<0.0050
	Barium	(mg/L)	0.11	@	0.23	@	<0.050	<0.050
	Boron	(mg/L)	<0.10	@	<0.10	@	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	@	<0.0030	@	<0.0030	<0.0030
	Cadmium	(mg/L)	<0.00010	@	<0.00010	@	<0.00010	<0.00010
	Calcium	(mg/L)	37	@	2.4	@	1.4	1.2
	Chromium	(mg/L)	<0.010	@	<0.010	@	<0.010	<0.010
	Cobalt	(mg/L)	<0.020	@	<0.020	@	<0.020	<0.020
	Copper	(mg/L)	<0.010	@	<0.010	@	<0.010	<0.010
	Iron	(mg/L)	0.32	@	<0.020	@	<0.020	<0.020
	Lead	(mg/L)	<0.0050	@	<0.0050	@	0.0093	<0.0050
	Magnesium	(mg/L)	2	@	0.44	@	0.23	0.18
	Manganese	(mg/L)	0.045	@	<0.010	@	0.014	<0.010
	Mercury	(mg/L)	<0.00020	@	<0.00020	@	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	@	<0.020	@	<0.020	<0.020
	Potassium	(mg/L)	2.5	@	3.8	@	1	<1.0
	Selenium	(mg/L)	<0.0020	@	<0.0020	@	<0.0020	<0.0020
	Silicon	(mg/L)	10	@	5.1	@	4.3	3.4
	Silver	(mg/L)	<0.030	@	<0.030	@	<0.030	<0.030
	Sodium	(mg/L)	2.3	@	19	@	1.7	1.5
	Thallium	(mg/L)	<0.0010	@	<0.0010	@	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	@	<0.020	@	<0.020	<0.020
	Zinc	(mg/L)	<0.010	@	<0.010	@	0.63	0.4

Ambient Groundwater Data

	Well Number:		M03131		M03132		M03701	
	Sample Date:		05/06/04		05/06/04		05/11/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<190	@	<190	@	<190	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	1.37E-01	@	4.26E-01	@	1.08E+00	NA
	±2	(sigma)	1.50E+00		1.30E+00		8.40E-01	
	MDA	(pCi/L)	1.40E+00		1.40E+00		5.80E-01	
	Gross Non-volatile Beta	(pCi/L)	2.98E+00	@	3.96E+00	@	1.30E+00	NA
	±2	(sigma)	7.50E-01		8.20E-01		6.10E-01	
	MDA	(pCi/L)	8.30E-01		8.70E-01		8.20E-01	
	Barium-140	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	7.00E+01		5.20E+01		3.40E+01	
	Cobalt-60	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.90E+00		1.70E+00		1.70E+00	
	Cesium-137	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.60E+00		1.70E+00		1.40E+00	
	Iodine-131	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	7.90E+01		5.80E+01		3.50E+01	
	Potassium-40	(pCi/L)	ND	@	ND	@	7.33E+00	NA
	±2	(sigma)					9.90E+00	
	MDA	(pCi/L)	1.90E+01		1.80E+01			
	Lead-210	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.50E+01		3.70E+01		3.70E+01	
	Radium-226	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.60E+01		2.90E+01		2.70E+01	
	Radium-228	(pCi/L)	ND	@	ND	@	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.00E+01		1.10E+01		8.90E+00	

Ambient Groundwater Data

	Well Number:		M06601		M06602		M06603	
	Sample Date:		05/12/04		05/12/04		05/17/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	NA	NA	NA	NA	20.7	NA
	pH	(S.U.)	NA	NA	NA	NA	7.18	NA
	Conductivity	(mS/cm)	NA	NA	NA	NA	0.209	NA
	Dissolved Oxygen	(mg/L)	NA	NA	NA	NA	8.34	NA
	Turbidity	(NTU)	NA	NA	NA	NA	0	NA
	Background Radiation	(uR/hr)	9.71	NA	9.71	NA	9.71	NA
	Sample Radiation	(uR/hr)	10.52	NA	9.71	NA	10.52	NA
Chemistry	Alkalinity	(mg/L)	5.7	5.4	94	93	110	110
	Pth. Alkalinity	(mg/L)	0	0	0	0	0	0
	Hardness (calculated)	(mg/L)	4.5	3.9	67	80	100	110
	pH, Lab	(S.U.)	6.1	6.2	8.0	7.9	7.8	7.9
	Specific Conductance (@25C)	(umhos/cm)	24.1	24.3	201	202	250	250
	Total Dissolved Solids	(mg/L)	12	16	100	100	160	160
	Total Organic Carbon	(mg/L)	<2.0	<2.0	3.1	2.3	2.8	<2.0
	Bromide	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride	(mg/L)	1.6	2.2	3.1	2.7	2.0	1.9
	Fluoride	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	0.12
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	0.028	0.3	0.049	0.053	<0.020	<0.020
	Nitrate	(mg/L)	0.028	0.3	0.049	0.053	<0.020	<0.020
	Ammonia	(mg/L)	0.1	0.12	0.12	0.084	0.082	0.094
	Total Kjeldahl Nitrogen	(mg/L)	*	*	*	*	0.18	0.22
	Phosphate, Ortho.	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Sulfate	(mg/L)	<5.0	<0.010	<0.010	<5.0	6.5	6.3
Metals	Aluminum	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	0.14
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Calcium	(mg/L)	1.5	1.3	26	31	40	32
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Iron	(mg/L)	0.025	<0.020	<0.020	<0.020	0.076	<0.020
	Lead	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	0.18	0.15	0.58	0.72	1.1	0.55
	Manganese	(mg/L)	<0.010	<0.010	<0.010	<0.010	0.042	<0.010
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	<1.0	<1.0	<1.0	<1.0	1.6	1.2
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	2.9	2.8	3.4	4.7	13	14
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.2	0.94	1.2	1.5	1.6	1.5
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	0.04	<0.010	<0.010	<0.010	<0.010	<0.010

Ambient Groundwater Data

	Well Number:		M06601		M06602		M06603	
	Sample Date:		05/12/04		05/12/04		05/17/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<190	NA	<190	NA	<190	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	4.57E-01	NA	1.50E+00	NA	8.20E-01	NA
	±2	(sigma)	6.20E-01		1.50E+00		1.70E+00	
	MDA	(pCi/L)	5.20E-01		1.10E+00		1.50E+00	
	Gross Non-volatile Beta	(pCi/L)	6.87E-01	NA	5.31E-01	NA	1.33E+00	NA
	±2	(sigma)	5.80E-01		5.90E-01		6.70E-01	
	MDA	(pCi/L)	8.30E-01		8.70E-01		9.00E-01	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	7.50E+01		7.20E+01		5.50E+01	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.80E+00		2.10E+00		2.00E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.30E+00		2.30E+00		2.30E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.00E+01		7.80E+01		5.30E+00	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.20E+01		1.80E+01		1.80E+01	
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.90E+02		4.80E+02		4.90E+02	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	5.60E+01		6.00E+01		5.80E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.40E+01		1.30E+01		1.40E+01	

Ambient Groundwater Data

	Well Number:		Blind Dup-02		M06604		M06605	
	Sample Date:		05/17/04		05/17/04		05/19/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	NA	NA	21.7	NA	21.5	NA
	pH	(S.U.)	NA	NA	6.79	NA	6.1	NA
	Conductivity	(mS/cm)	NA	NA	0.17	NA	0.063	NA
	Dissolved Oxygen	(mg/L)	NA	NA	8.77	NA	8.68	NA
	Turbidity	(NTU)	NA	NA	0	NA	0	NA
	Background Radiation	(uR/hr)	NA	NA	9.71	NA	10.52	NA
	Sample Radiation	(uR/hr)	NA	NA	10.52	NA	6.47	NA
Chemistry	Alkalinity	(mg/L)	110	110	87	85	34	34
	Pth. Alkalinity	(mg/L)	0	0	0	0	0	0
	Hardness (calculated)	(mg/L)	110	110	80	83	35	35
	pH, Lab	(S.U.)	7.9	7.9	7.4	7.5	6.7	6.6
	Specific Conductance (@25C)	(umhos/cm)	251	251	196	195	107	108
	Total Dissolved Solids	(mg/L)	160	154	128	142	76	76
	Total Organic Carbon	(mg/L)	<2.0	3	2.3	<2.0	2.8	3.1
	Bromide	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride	(mg/L)	2.6	2.3	1.9	1.8	1.6	1.9
	Fluoride	(mg/L)	<0.10	<0.10	0.12	0.12	<0.10	<0.10
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Ammonia	(mg/L)	0.11	0.096	0.08	0.1	0.1	0.1
	Total Kjeldahl Nitrogen	(mg/L)	0.2	0.21	0.21	0.23	0.36	0.1
	Phosphate, Ortho.	(mg/L)	<0.020	<0.020	<0.020	<0.020	0.078	0.1
	Sulfate	(mg/L)	6.2	6.2	8.9	6.9	10	11
Metals	Aluminum	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.003	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	<0.050	<0.050	<0.050	<0.050	0.13	0.13
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Calcium	(mg/L)	43	41	30	31	13	13
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Iron	(mg/L)	0.1	0.091	0.43	0.44	0.61	0.63
	Lead	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	1.1	1.1	1.3	1.3	0.66	0.67
	Manganese	(mg/L)	0.044	0.043	0.052	0.054	0.024	0.024
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	1.7	1.6	2.1	2.1	2.3	2.3
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	15	17	18	18	6.7	6.9
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.5	1.5	1.5	1.5	1.2	1.2
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	<0.010	<0.010	<0.010	<0.010	1.1	1.1

Ambient Groundwater Data

	Well Number:		Blind Dup-02		M06604		M06605	
	Sample Date:		05/17/04		05/17/04		05/19/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<190	NA	<187	NA	<187	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	6.74E-01	NA	4.74E-01	NA	1.34E+00	NA
	±2	(sigma)	1.70E+00		1.80E+00		1.40E+00	
	MDA	(pCi/L)	1.50E+00		1.80E+00		9.90E-01	
	Gross Non-volatile Beta	(pCi/L)	2.55E+00	NA	2.37E+00	NA	3.14E+00	NA
	±2	(sigma)	7.50E-01		7.70E-01		7.60E-01	
	MDA	(pCi/L)	8.90E-01		9.40E-01		8.50E-01	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	5.80E+01		6.20E+01		5.00E+00	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.10E+00		2.10E+00		2.30E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.30E+00		2.30E+00		1.90E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	5.70E+01		5.90E+01		4.90E+01	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.30E+01		1.90E+01		2.10E+01	
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.70E+02		4.80E+02		4.70E+02	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	5.20E+01		5.20E+01		5.40E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.30E+01		1.30E+01		1.40E+01	

Ambient Groundwater Data

	Well Number:		M06608		M03101		M03102	
	Sample Date:		05/19/04		05/24/04		06/07/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	22.8	NA	26	NA	x	@
	pH	(S.U.)	6.34	NA	7.75	NA	x	@
	Conductivity	(mS/cm)	0.056	NA	0.119	NA	x	@
	Dissolved Oxygen	(mg/L)	9.14	NA	8.07	NA	x	@
	Turbidity	(NTU)	0	NA	15	NA	x	@
	Background Radiation	(uR/hr)	10.52	NA	18.61	NA	x	@
	Sample Radiation	(uR/hr)	6.47	NA	12.95	NA	x	@
Chemistry	Alkalinity	(mg/L)	23	5.4	46	46	28	NA
	Pth. Alkalinity	(mg/L)	0	0	1.3	<1.0	<1.0	NA
	Hardness (calculated)	(mg/L)	17	7.6	4.9	3.6	12	NA
	pH, Lab	(S.U.)	6.9	5.8	8.5	8.3	8.5	NA
	Specific Conductance (@25C)	(umhos/cm)	88.1	48.2	130	130	69.7	NA
	Total Dissolved Solids	(mg/L)	64	56	90	68	34	NA
	Total Organic Carbon	(mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0	NA
	Bromide	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	NA
	Chloride	(mg/L)	1.5	1.6	2.0	1.7	3.3	NA
	Fluoride	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	NA
	Nitrite	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	NA
	Nitrate/Nitrite	(mg/L)	<0.020	<0.020	<0.020	0.025	<0.020	NA
	Nitrate	(mg/L)	<0.020	<0.020	<0.020	0.025	<0.020	NA
	Ammonia	(mg/L)	*	0.12	0.16	*	0.11	NA
	Total Kjeldahl Nitrogen	(mg/L)	*	*	0.23	*	0.11	NA
	Phosphate, Ortho.	(mg/L)	0.034	0.046	0.044	0.032	0.061	NA
	Sulfate	(mg/L)	11	13	16	13	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	<0.10	0.19	<0.10	0.18	NA
	Antimony	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NA
	Barium	(mg/L)	0.11	<0.050	<0.050	<0.050	<0.050	NA
	Boron	(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	NA
	Beryllium	(mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	NA
	Calcium	(mg/L)	5.8	2.5	1.9	1.4	4.1	NA
	Chromium	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	NA
	Cobalt	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	NA
	Copper	(mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010	NA
	Iron	(mg/L)	0.6	0.52	0.099	0.02	11	NA
	Lead	(mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NA
	Magnesium	(mg/L)	0.52	0.34	<0.050	<0.050	<0.050	NA
	Manganese	(mg/L)	0.027	0.024	<0.010	<0.010	0.15	NA
	Mercury	(mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	NA
	Nickel	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	NA
	Potassium	(mg/L)	5.6	1.3	2.1	2	7.2	NA
	Selenium	(mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	NA
	Silicon	(mg/L)	6		6.6	6.4	1.3	NA
	Silver	(mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030	NA
	Sodium	(mg/L)	2.1	1.2	22	22	2.8	NA
	Thallium	(mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	NA
	Vanadium	(mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020	NA
	Zinc	(mg/L)	1	5.1	1.1	0.04	0.28	NA

Ambient Groundwater Data

	Well Number:		M06608		M03101		M03102	
	Sample Date:		05/19/04		05/24/04		06/07/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<187	NA	<187	NA	<187	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	9.89E-01	NA	NA	NA	1.18E+00	NA
	±2	(sigma)	1.50E+00				1.30E+00	
	MDA	(pCi/L)	1.20E+00				1.00E+00	
	Gross Non-volatile Beta	(pCi/L)	6.36E+00	NA	NA	NA	8.66E+00	NA
	±2	(sigma)	9.60E-01				1.00E+00	
	MDA	(pCi/L)	8.90E-01				8.60E-01	
	Barium-140	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	3.40E+01				4.50E+01	
	Cobalt-60	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.90E+00				2.30E+00	
	Cesium-137	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.50E+00				2.40E+00	
	Iodine-131	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.80E+01				3.50E+01	
	Potassium-40	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.60E+01				2.40E+01	
	Lead-210	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.50E+01				5.00E+02	
	Radium-226	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.60E+01				6.20E+01	
	Radium-228	(pCi/L)	ND	NA	NA	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.10E+01				1.30E+01	

Ambient Groundwater Data

	Well Number:		M03103		Blind Dup-03		M03104	
	Sample Date:		06/07/04		05/19/04		06/16/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	x	@	NA	NA	22	NA
	pH	(S.U.)	x	@	NA	NA	7.25	NA
	Conductivity	(mS/cm)	x	@	NA	NA	0.147	NA
	Dissolved Oxygen	(mg/L)	x	@	NA	NA	8.89	NA
	Turbidity	(NTU)	x	@	NA	NA	71	NA
	Background Radiation	(uR/hr)	9.71	@	NA	NA	11.33	NA
	Sample Radiation	(uR/hr)	8.91	@	NA	NA	11.18	NA
Chemistry	Alkalinity	(mg/L)	14	NA	140	130	140	130
	Pth. Alkalinity	(mg/L)	0	NA	0	0	0	0
	Hardness (calculated)	(mg/L)	11	NA	150	100	150	110
	pH, Lab	(S.U.)	6.1	NA	7.8	7.8	7.8	7.8
	Specific Conductance (@25C)	(umhos/cm)	47	NA	271	270	272	272
	Total Dissolved Solids	(mg/L)	52	NA	180	190	180	180
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	<2.0	<2.0	<2.0
	Bromide	(mg/L)	0.021	NA	<0.020	<0.020	0.022	<0.020
	Chloride	(mg/L)	3.8	NA	3.1	3.2	3.2	3.2
	Fluoride	(mg/L)	<0.10	NA	0.11	0.11	0.12	0.12
	Nitrite	(mg/L)	<0.020	NA	<0.020	<0.020	<0.020	<0.020
	Nitrate/Nitrite	(mg/L)	0.022	NA	<0.020	<0.020	0.025	<0.020
	Nitrate	(mg/L)	0.022	NA	<0.020	<0.020	0.025	<0.020
	Ammonia	(mg/L)	0.14	NA	0.16	0.13	*	0.15
	Total Kjeldahl Nitrogen	(mg/L)	<0.10	NA	0.38	0.3	*	0.28
	Phosphate, Ortho.	(mg/L)	<0.020	NA	<0.020	<0.020	0.020	<0.020
	Sulfate	(mg/L)	<5.0	NA	9.4	9.2	9.2	9.8
Metals	Aluminum	(mg/L)	<0.10	NA	0.79	<0.10	0.72	<0.10
	Antimony	(mg/L)	<0.0030	NA	<0.0030	<0.0030	<0.0030	<0.0030
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	<0.0050	<0.0050	<0.0050
	Barium	(mg/L)	0.061	NA	<0.050	<0.050	<0.050	<0.050
	Boron	(mg/L)	<0.10	NA	<0.10	<0.10	<0.10	<0.10
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	<0.0030	0.0035	0.0035
	Cadmium	(mg/L)	<0.00010	NA	0.00023	<0.00010	0.00016	<0.00010
	Calcium	(mg/L)	4.2	NA	56	35	55	39
	Chromium	(mg/L)	<0.010	NA	0.015	<0.010	0.019	<0.010
	Cobalt	(mg/L)	<0.020	NA	<0.020	<0.020	<0.020	<0.020
	Copper	(mg/L)	<0.010	NA	<0.010	<0.010	<0.010	<0.010
	Iron	(mg/L)	5.5	NA	3.4	0.15	3.2	0.17
	Lead	(mg/L)	<0.0050	NA	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium	(mg/L)	0.16	NA	3.8	3.2	3.90	3.5
	Manganese	(mg/L)	0.37	NA	0.03	0.014	0.034	0.02
	Mercury	(mg/L)	<0.00020	NA	<0.00020	<0.00020	<0.00020	<0.00020
	Nickel	(mg/L)	<0.020	NA	<0.020	<0.020	<0.020	<0.020
	Potassium	(mg/L)	2.4	NA	3.6	2.7	3.6	3.3
	Selenium	(mg/L)	<0.0020	NA	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon	(mg/L)	5.5	NA	15	11	16	13
	Silver	(mg/L)	<0.030	NA	<0.030	<0.030	<0.030	<0.030
	Sodium	(mg/L)	1.9	NA	2.8	2.5	2.8	2.8
	Thallium	(mg/L)	<0.0010	NA	<0.0010	<0.0010	<0.0010	<0.0010
	Vanadium	(mg/L)	<0.020	NA	<0.020	<0.020	<0.020	<0.020
	Zinc	(mg/L)	0.019	NA	0.08	<0.010	0.068	<0.010

Ambient Groundwater Data

	Well Number:		M03103		Blind Dup-03		M03104	
	Sample Date:		06/07/04		05/19/04		06/16/04	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<187	NA	<187	NA	<187	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	2.48E+00	NA	2.50E+00	NA	3.50E+00	NA
	±2	(sigma)	1.20E+00		2.50E+00		2.70E+00	
	MDA	(pCi/L)	8.40E-01		2.10E+00		1.90E+00	
	Gross Non-volatile Beta	(pCi/L)	3.44E+00	NA	5.14E+00	NA	5.84E+00	NA
	±2	(sigma)	7.60E-01		9.40E-01		1.00E+00	
	MDA	(pCi/L)	8.30E-01		9.30E-01		1.00E+00	
	Barium-140	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	pCi/L)	4.30E+01		2.80E+01		1.60E+01	
	Cobalt-60	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.30E+00		2.20E+00		1.70E+00	
	Cesium-137	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.40E+00		2.10E+00		1.40E+00	
	Iodine-131	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.60E+01		2.00E+01		8.50E+00	
	Potassium-40	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.10E+01		2.10E+01		1.70E+01	
	Lead-210	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.70E+02		4.70E+02		3.40E+01	
	Radium-226	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	5.90E+01		6.10E+01		2.60E+01	
	Radium-228	(pCi/L)	ND	NA	ND	NA	ND	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.40E+01		1.50E+01		9.10E+00	

Ambient Groundwater Data

		Well Number:	M03702	M03703	M03704	M03705
		Sample Date:	04/19/04		04/20/04	04/21/04
Field Measurements	Temperature	(C)	20.6		21	
	pH	(S.U.)	6.35		2.41	
	Conductivity	(mS/cm)	0.152		0.214	
	Dissolved Oxygen	(mg/L)				
	Turbidity	(NTU)	1		1	
	Background Radiation	(uR/hr)				
	Sample Radiation	(uR/hr)				
	Uranium-234	(pCi/L)	7.75E-02		3.21E-02	3.40E-02
	±2	(sigma)	5.6E-02		2.8E-02	2.7E-02
	MDA	(pCi/L)	5.1E-02		3.1E-02	2.1E-02
	Uranium-235	(pCi/L)	3.2E-03		1.46E-02	9.89E-03
	±2	(sigma)	3.0E-02		2.3E-02	1.9E-02
	MDA	(pCi/L)	6.1E-02		2.9E-02	2.2E-02
	Uranium-238	(pCi/L)	4.7E-02		1.5E-02	1.7E-02
	±2	(sigma)	4.5E-02		2.1E-02	2.0E-02
	MDA	(pCi/L)	4.30E-02		2.80E-02	1.90E-02
	Radium-226	(pCi/L)	1.15E-01		7.26E-02	5.4E-01
	±2	(sigma)	2.3E-02		1.7E-02	6.9E-02
	MDA	(pCi/L)	1.70E-02		1.70E-02	1.60E-02
	Radium-228	(pCi/L)	5.36E-01		4.84E-01	7.46E-01
	±2	(sigma)	5.4E-01		5.1E-01	5.4E-01
	MDA	(pCi/L)	8.70E-01	8.50E-01	8.3E-01	8.30E-01

	Well Number:	M03706	M03707	DUP-01	M03708
	Sample Date:	04/21/04	04/22/04	04/22/04	05/04/04
Field Measurements	Temperature		22.0		22.9
	pH		5.84		6.61
	Conductivity		0.114		0.103
	Dissolved Oxygen		0.9		
	Turbidity		0		0
	Background Radiation	8.9	10.52		13.75
	Sample Radiation		15.37		10.52
	Uranium-234	4.88E-02	2.87E-02	3.82E-02	3.86E-02
	±2	3.1E-02	2.2E-02	2.7E-02	2.6E-02
	MDA	1.30E-02	1.1E-02	2.1E-02	2.3E-02
	Uranium-235	0.0E+00	0.0E+00	8.4E-03	-2.98E-03
	±2	1.0E-02	1.3E-02	1.7E-02	1.0E-02
	MDA	1.6E-02	2.9E-02	2.3E-02	2.7E-02
	Uranium-238	3.85E-02	1.4E-02	2.37E-02	1.37E-02
	±2	2.9E-02	1.6E-02	2.1E-02	1.7E-02
	MDA	2.30E-02	1.10E-02	1.20E-02	1.90E-02
	Radium-226	1.13E+00	8.63E-01	7.99E-01	7.10E-01
	±2	1.5E-01	1.1E-01	1.0E-01	9.9E-02
	MDA	1.70E-02	1.70E-02	1.60E-02	1.60E-02
	Radium-228	4.51E-01	6.11E-01	1.08E+00	9.05E-01
	±2	5.8E-01	5.8E-01	6.4E-01	5.7E-01
	MDA	9.50E-01	9.40E-01	9.8E-01	8.70E-01

Ambient Groundwater Data

	Well Number:	M03709	M03131	M03132	M03701
	Sample Date:	05/05/04	05/06/04	05/06/04	05/11/04
Field Measurements	Temperature				
	pH				
	Conductivity				
	Dissolved Oxygen				
	Turbidity				
	Background Radiation				
	Sample Radiation				
	Uranium-234	5.09E-02	4.17E-02	1.54E-02	8.93E-02
	±2	3.1E-02	2.8E-02	2.0E-02	3.8E-02
	MDA	2.5E-02	2.6E-02	2.6E-02	1.1E-02
	Uranium-235	4.9E-03	1.36E-02	1.69E-02	4.46E-03
	±2	1.4E-02	1.8E-02	2.1E-02	1.3E-02
	MDA	1.5E-02	1.4E-02	2.4E-02	1.3E-02
	Uranium-238	1.65E-02	1.9E-02	5.26E-02	6.6E-02
	±2	1.9E-02	1.9E-02	1.4E-02	3.3E-02
	MDA	1.20E-02	1.10E-02	2.30E-02	1.90E-02
	Radium-226	4.43E-01	3.0E-01	1.75E-01	2.19E-01
	±2	6.1E-02	4.3E-02	2.9E-02	3.4E-02
	MDA	1.60E-02	1.50E-02	1.60E-02	1.40E-02
	Radium-228	7.37E-01	2.26E-01	3.65E-01	2.93E-01
	±2	5.6E-01	5.3E-01	5.2E-01	5.0E-01
	MDA	8.70E-01	9.00E-01	8.70E-01	8.40E-01

	Well Number:	M06601	M06602	M06603	DUP-02
	Sample Date:	05/12/04	05/12/04	05/17/04	05/17/04
Field Measurements	Temperature				
	pH				
	Conductivity				
	Dissolved Oxygen				
	Turbidity				
	Background Radiation	9.71	9.71	9.71	
	Sample Radiation	10.52	9.71	10.52	
	Uranium-234	4.91E-02	1.55E-02	1.40E-01	5.90E-02
	±2	3.4E-02	5.8E-02	1.1E-01	3.5E-02
	MDA	3.0E-02	2.4E-02	9.5E-02	2.8E-02
	Uranium-235	3.9E-02	1.2E-02	-9.69E-03	1.5E-02
	±2	3.3E-02	2.1E-02	4.9E-02	2.2E-02
	MDA	2.8E-02	1.8E-02	1.2E-02	2.6E-02
	Uranium-238	2.99E-02	7.5E-02	9.9E-02	1.9E-02
	±2	2.8E-02	4.1E-02	9.9E-02	2.3E-02
	MDA	3.00E-02	2.10E-02	1.10E-01	2.80E-02
	Radium-226	2.16E-01	1.31E-01	1.10E-01	1.44E-01
	±2	3.5E-02	2.5E-02	2.2E-02	2.6E-02
	MDA	1.80E-02	1.50E-02	1.60E-02	1.80E-02
	Radium-228	6.58E-01	9.8E-01	-7.66E-02	-2.76E-02
	±2	6.4E-01	5.9E-01	5.7E-01	4.3E-01
	MDA	1.00E+00	1.00E+00	1.00E+00	7.70E-01

Ambient Groundwater Data

	Well Number:	M06604	M06605	M06608	M03101
	Sample Date:	05/17/04	05/19/04	05/19/04	05/24/04
Field Measurements	Temperature	21.7	21.5	22.8	26.0
	pH	6.79	6.1	6.34	7.75
	Conductivity	0.17	0.063	0.056	0.119
	Dissolved Oxygen	8.77	8.68	9.14	8.07
	Turbidity	0	0	0	15
	Background Radiation	9.71	10.52	10.52	18.61
	Sample Radiation	10.52	6.47	6.47	12.95
	Uranium-234	6.45E-02	1.83E-02	5.96E-02	
	±2	4.7E-02	2.4E-02	3.7E-02	
	MDA	3.5E-02	3.1E-02	2.7E-02	
	Uranium-235	0.0E+00	4.9E-03	2.2E-02	
	±2	1.9E-02	1.9E-02	2.8E-02	
	MDA	2.6E-02	3.0E-02	3.4E-02	
	Uranium-238	2.1E-02	3.1E-02	1.76E-02	
	±2	3.0E-02	2.8E-02	2.4E-02	
	MDA	3.10E-02	2.30E-02	3.00E-02	
	Radium-226	4.69E-03	8.67E-01	5.0E-01	
	±2	1.0E-02	1.2E-01	6.4E-02	
	MDA	1.80E-02	1.70E-02	1.50E-02	
	Radium-228	1.10E-01	5.65E-01	4.38E-01	
	±2	4.6E-01	4.9E-01	5.3E-01	
	MDA	8.00E-01	7.7E-01	8.60E-01	

	Well Number:	M03102	M03103	DUP-03	M03104
	Sample Date:	06/07/04	06/07/04	05/19/04	06/16/04
Field Measurements	Temperature				22.0
	pH				7.25
	Conductivity				0.147
	Dissolved Oxygen				8.89
	Turbidity				71
	Background Radiation	9.71	9.71		11.33
	Sample Radiation	9.71	8.91		11.18
	Uranium-234	1.05E-02	4.39E-02	1.18E-01	1.54E-01
	±2	5.3E-02	3.9E-02	5.2E-02	5.5E-02
	MDA	2.6E-02	3.7E-02	1.6E-02	2.3E-02
	Uranium-235	1.48E-02	-8.89E-04	1.9E-02	1.5E-02
	±2	2.6E-02	1.7E-02	2.6E-02	2.2E-02
	MDA	2.2E-02	3.4E-02	2.7E-02	2.5E-02
	Uranium-238	1.2E-02	1.9E-02	1.39E-01	1.6E-01
	±2	2.2E-02	2.7E-02	5.7E-02	5.5E-02
	MDA	1.90E-02	3.20E-02	1.60E-02	1.30E-02
	Radium-226	1.81E-01	8.09E-01	2.52E-01	2.63E-01
	±2	3.2E-02	9.8E-02	3.9E-02	3.8E-02
	MDA	1.70E-02	1.60E-02	1.60E-02	1.50E-02
	Radium-228	5.27E-01	1.76E-01	-7.21E-02	-8.90E-02
	±2	6.7E-01	6.6E-01	6.0E-01	6.1E-01
	MDA	1.10E+00	1.1E+00	1.10E+00	1.10E+00

2.1.5 Summary Statistics
Ambient Groundwater

Nonrandom Background

Analyte	Statistics	Concentration
Gross Alpha	Average	1.35
	Standard Deviation	0.17
	Median	1.20
	Skew	1.73
Ra-226	Average	0.01
	Standard Deviation	0.01
	Median	0.00
	Skew	1.73
Ra-228	Average	0.49
	Standard Deviation	0.26
	Median	0.40
	Skew	1.33
Total U	Average	0.00
	Standard Deviation	0.00
	Median	0.00
	Skew	NA

Nonrandom Perimeter

Analyte	Statistics	Concentration
Gross Alpha	Average	0.90
	Standard Deviation	0.26
	Median	1.00
	Skew	-1.46
Ra-226	Average	0.08
	Standard Deviation	0.08
	Median	0.08
	Skew	0.00
Ra-228	Average	0.65
	Standard Deviation	0.58
	Median	0.86
	Skew	-1.40
Total U	Average	0.00
	Standard Deviation	0.00
	Median	0.00
	Skew	NA

Random Background

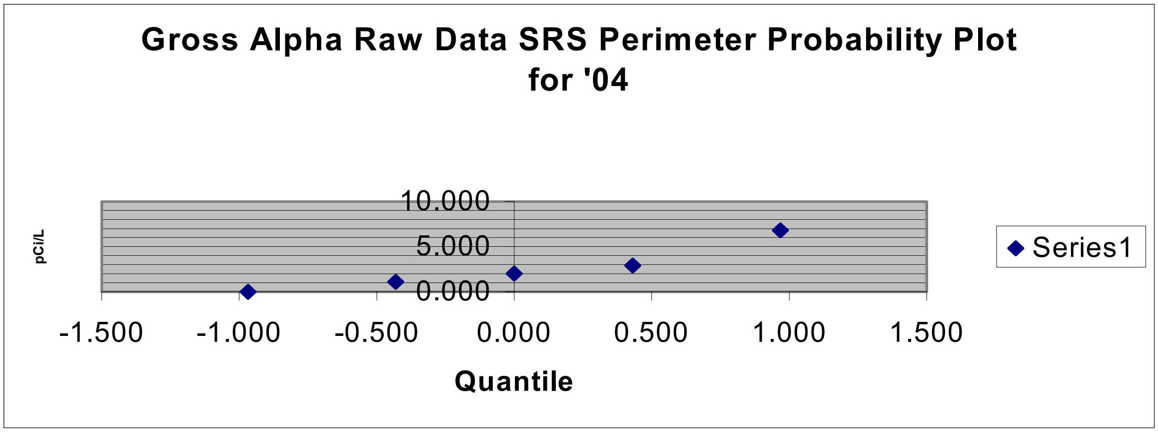
Analyte	Statistics	Concentration
Gross Alpha	Average	2.03
	Standard Deviation	1.74
	Median	1.70
	Skew	0.87
Ra-226	Average	0.51
	Standard Deviation	0.67
	Median	0.25
	Skew	1.39
Ra-228	Average	1.34
	Standard Deviation	0.91
	Median	1.30
	Skew	0.90
Total U	Average	0.00
	Standard Deviation	0.00
	Median	0.00
	Skew	NA

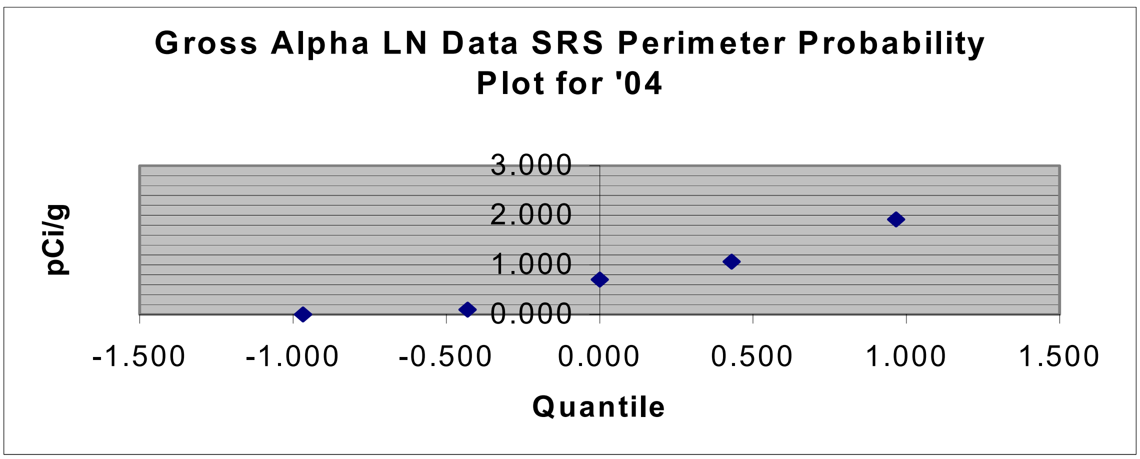
Random Perimeter

Analyte	Statistics	Concentration
Gross Alpha	Average	2.56
	Standard Deviation	2.60
	Median	2.02
	Skew	1.32
Ra-226	Average	10.07
	Standard Deviation	21.76
	Median	0.34
	Skew	2.23
Ra-228	Average	1.02
	Standard Deviation	0.63
	Median	1.10
	Skew	0.09
Total U	Average	0.00
	Standard Deviation	0.00
	Median	0.00
	Skew	NA

Summary Statistics
Ambient Groundwater

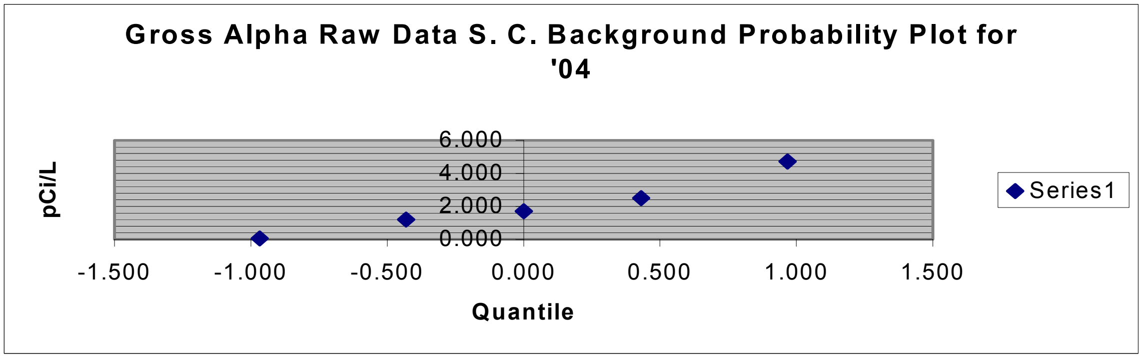
Figure 1. Probability plots for gross alpha

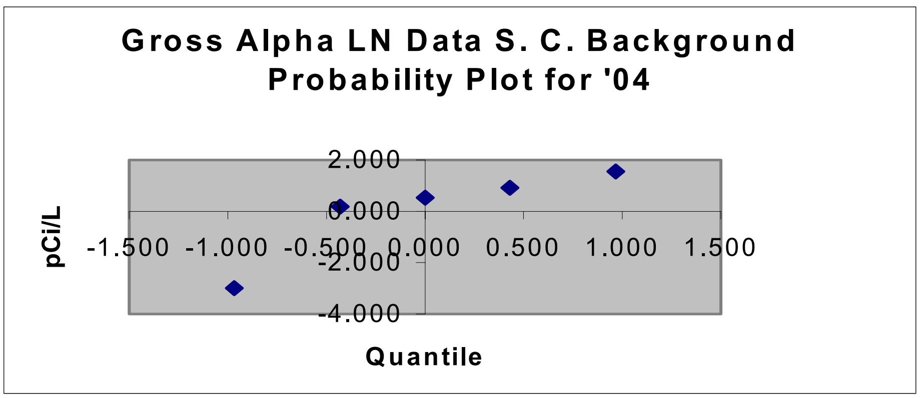




Summary Statistics
Ambient Groundwater

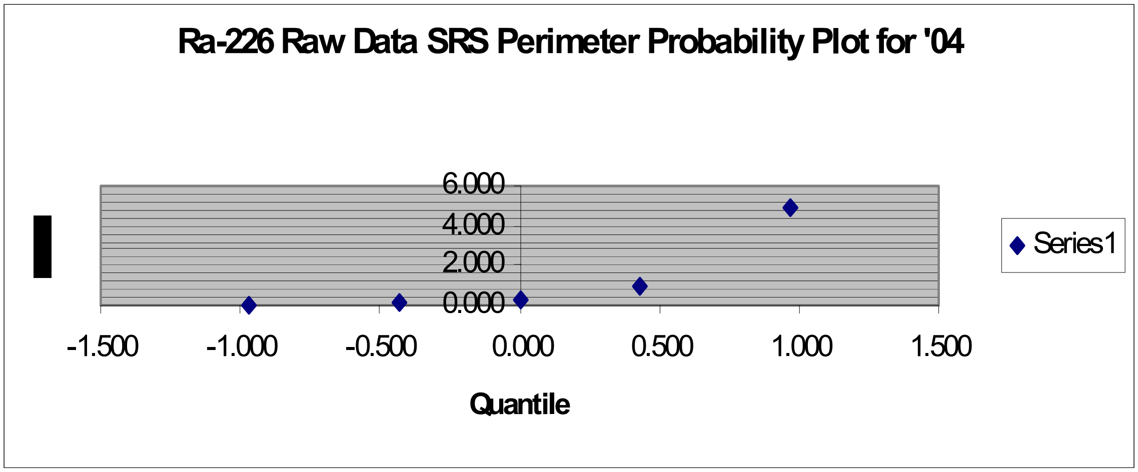
Figure 1. cont.

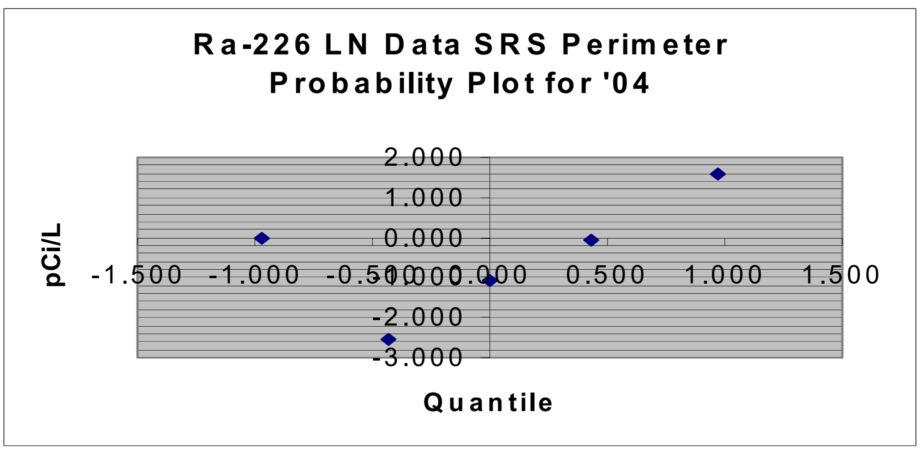




Summary Statistics
Ambient Groundwater

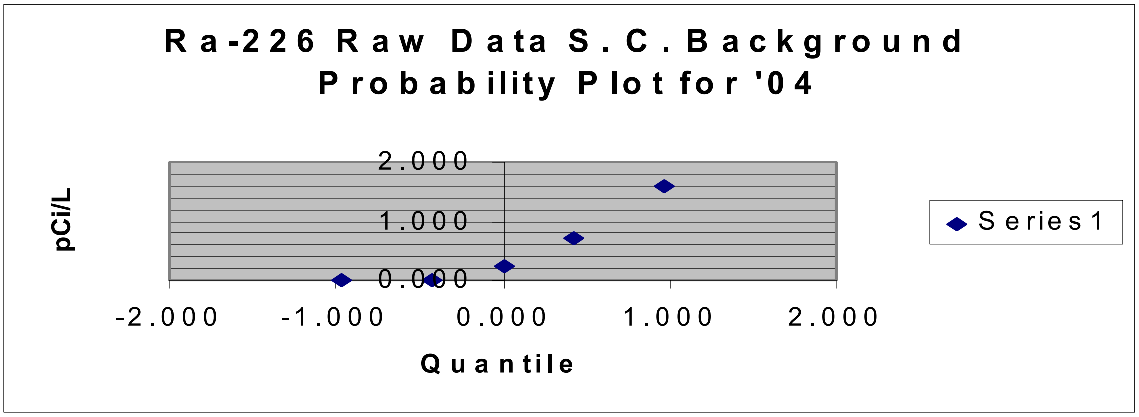
Figure 2. Probability plots for Ra-226

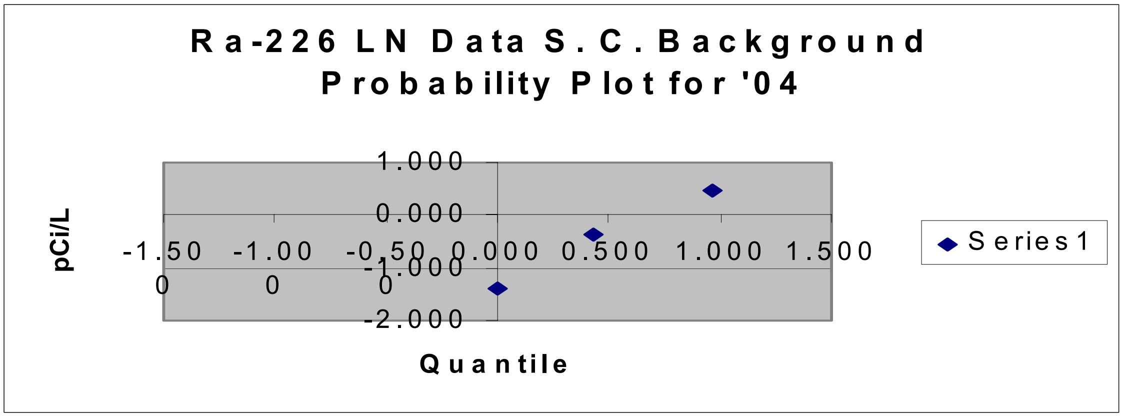




Summary Statistics
Ambient Groundwater

Figure 2. cont.





2.2 Drinking Water Quality Monitoring

2.2.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) Drinking Water Monitoring Project evaluates drinking water quality to provide assurance to the public that municipal drinking water systems adjacent to Savannah River Site (SRS) and Vogle Electrical Generating Plant (VEGP) have not been impacted by radiological constituents. The project objectives are to collect monthly composite raw surface water fed drinking water samples from water treatment plants using the lower portion of the Savannah River, and to collect quarterly grab samples from selected municipal and large community ground water fed drinking water systems within 30 miles of SRS (Map 4, section 2.2.2). ESOP analyzed samples for gross alpha, nonvolatile beta, gamma-emitting radionuclides, and tritium.

The Department of Energy- Savannah River (DOE-SR) historically sampled 19 water systems semi-annually for radiological constituents. Routine sampling ended on the 16 groundwater fed systems in mid-1996 when this sampling element was discontinued from the DOE-SR monitoring program. The remaining three, which use surface water sources, are currently being sampled by DOE-SR.

The South Carolina Department of Health and Environmental Control (SCDHEC) currently monitors all community/municipal water systems for various contaminants, including radionuclides. ESOP requires monitoring for man-made and naturally occurring radionuclides for a minimum of four consecutive quarters during system start-up. Monitoring continues quarterly if the running average exceeds the United States Environmental Protection Agency (EPA) maximum contamination level (MCL). Monitoring is reduced to once every four years if activities are below the MCL. ESOP has expanded this monitoring by sampling selected systems biannually and collecting monthly composites of raw surface water from water treatment plants that use the lower portion of the Savannah River.

The study area was established as a 30-mile radius circle centered in SRS. All public water systems in the study area were identified using the ESOP Geographical Information System. All of the municipal and large community systems within the study area were selected for sampling. Of the systems selected, 17 were groundwater fed and three were surface water fed systems. These systems serve approximately 203,000 customers with nearly 40,000 receiving their water from groundwater sources. Monthly and quarterly samples were labeled, preserved, and transferred to a laboratory with a chain-of-custody. Samples were submitted to the Region 5 Laboratory for tritium analysis. Gamma spectroscopy, gross alpha, and gross nonvolatile beta analyses were conducted by SCDHEC Radiological Environmental Monitoring Laboratory. All data collected was verified, validated, and stored in project files and spreadsheets.

The ESOP Drinking Water Monitoring Project continues to be an important source of essential data for assessing human health exposure pathways. ESOP will continue sampling to provide the public with an independent source of radiological data for drinking water systems.

RESULTS AND DISCUSSION

Drinking Water System Results

Based on a review of the analytical data, five of the 18 municipal and large community systems sampled had tritium activities above the Lower Limit of Detection (LLD) (section 2.2.4). The activities detected ranged from <196 to 503 pCi/L. These tritium activities are measurable but not significant when compared with the 20,000 picocuries per liter (pCi/L) United States Environmental Protection Agency maximum contaminant level (MCL) (USEPA 2002). All five of these systems are north of SRS. Elevated tritium activities in these systems are potentially due to rainwater infiltration into the shallow unconfined aquifer that is present in this area.

Gamma-emitting radionuclides were not detected above the Minimum Detectable Activity (MDA). Gross alpha was detected in four samples. All gross alpha samples were below the EPA MCL of 15 pCi/L (USEPA 2002). If gross alpha and non-volatile beta exceed the trigger levels of >15 pCi/L or > 8 pCi/L respectively, they will be re-analyzed for isotopic parameters. The gross alpha that was detected was from a well in Jackson, which is now no longer in use. The Town of Jackson gross alpha detection is due to radium. The town is currently working on adding a new well to alleviate the situation. They are hoping to have the new well open by June of 2006.

Raw Surface Water Results

Based on a review of the raw surface water data from the Savannah River, tritium was detected above the LLD in every monthly composite from the downstream raw water intakes (i.e., Beaufort -Jasper and City of Savannah). Tritium activity in these samples had an average of 498 picocuries/ liter (pCi/L) and ranged from 280 to 965 pCi/L. Two of the North Augusta raw water composites were slightly above the LLD. Section 2.2.4 summarizes the tritium activities for the raw water composites.

To better explain the river flow fluctuations throughout the year and minimize the effect this has on data collected throughout the year, a data averaging process know as normalizing was used to better explain the “snapshot” of the 2004 data collected. Tritium activities were normalized to the average monthly river discharge at a United States Geological Survey (USGS) gauging station near the Beaufort-Jasper intake (SCDNR 2004). After normalization, the two downstream intakes had an average of 267.875 curies/month and ranged from 132.41 to 691.06curies/month. The averages of the monthly composites were used to estimate the annual transport of tritium down the Savannah River. Based on ESOP drinking water sampling from the North Augusta, Beaufort-Jasper, and City of Savannah water systems, approximately 3214.5 curies of tritium were transported down the river during 2004. Both SRS and Vogtle Electrical generating Plant (VEGP) contributed to the tritium concentration found in the Savannah River (section 2.2.4).

Gamma-emitting radionuclides were not detected above the Cs 137 MDA for the monthly raw surface water composite samples. Gross alpha was detected above the MDA in one sample at 2.97 pCi/L. Gross alpha was below the respective EPA MCLs. Analytical results for the raw surface water composite samples are summarized in section 2.2.4.

Finished Ground Water and Raw Surface Water Statistical Comparison

The gross alpha detectable average for ground water fed drinking water systems in 2004 was 3.72 pCi/L. Raw surface water fed systems had only one detectable gross alpha in 2004 at 2.97 pCi/L. The tritium detectable average for ground water fed systems was 300 pCi/L. The tritium detectable average for raw surface water was 408 pCi/L.

The detectable gross alpha in raw surface water was within one standard deviation of ground water systems. The detectable tritium was within two standard deviations of ground water systems. There was no detectable gross non-volatile beta or gamma-emitting radionuclides found in either raw surface water or ground water systems in 2004.

Summary statistics are given in section 2.2.5.

DOE-SR Data Comparison

DOE-SR conducts monthly composite sampling at the three water treatment plants using the Savannah River. Based on the DOE-SR 2004 annual report, tritium in the two downstream raw water intakes averaged 360.0 pCi/L and ranged from –232.0 to 1080.0 pCi/L (WSRC 2005).

Based on the DOE-SR sampling effort, an estimated 3630 curies of tritium were transported down the Savannah River in 2004. The ESOP normalized detection estimate, based on raw water samples collected at North Augusta, Beaufort-Jasper, and City of Savannah water systems, was 3214.5 curies compared to the DOE-SR estimate of 3630 curies of tritium released in 2004.

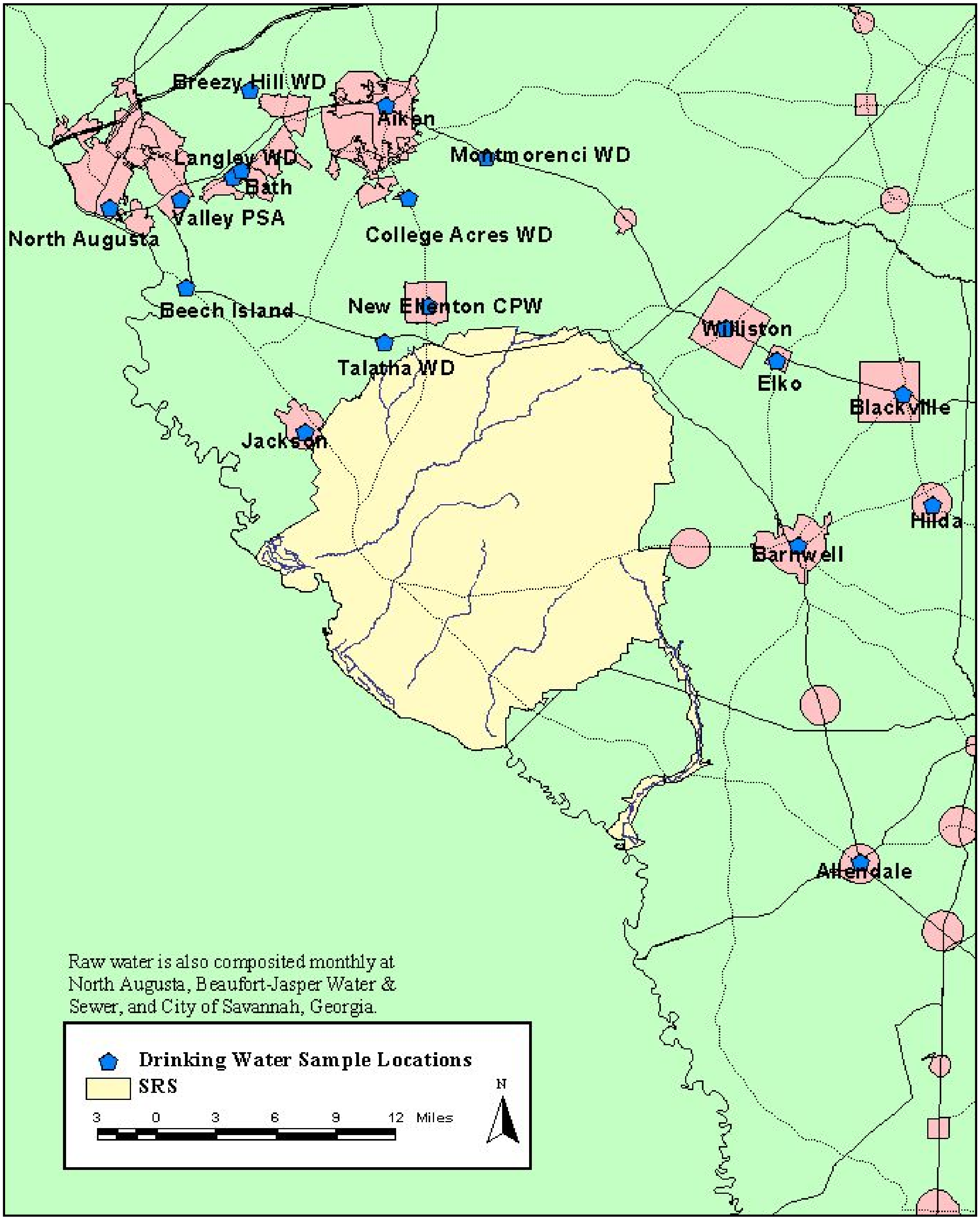
Gross alpha, nonvolatile beta, and gamma-emitting radionuclides detected by DOE-SR were below ESOP MDAs.

CONCLUSIONS AND RECOMMENDATIONS

Tritium continues to be the most abundant radionuclide detected in public drinking water supplies potentially impacted by SRS and VEGP. It was detected in both groundwater and surface water fed systems. However, these tritium activities were relatively low considering the 20,000 pCi/L MCL for drinking water. Gross alpha, gross beta, and gamma-emitting radionuclides were not detected at activities above their respective MCLs. ESOP detected approximately 88.6 percent of the tritium released by Plant Vogtle and the SRS without detecting any drinking water exceedences. Comparative analysis with DOE-SR for ground water systems cannot be done, because DOE-SR does not sample systems off of the Savannah River Site.

A copy of the analytical data reports and sample log sheets are contained in the project file. ESOP will continue sampling to provide the public with an independent source of radiological data for ground water systems.

2.2.2
Map 4. Drinking Water Monitoring Locations



2.2.3 Tables and Figures
Drinking Water Quality Monitoring

Table 1. Drinking Water Systems Sampled by ESOP

System Number	System Name	Number of Taps	Population Served
210001	Aiken	16,633	38,021
210002	Jackson	1,217	3,602
210003	North Augusta	NA	NA
210007	New Ellwnton	1,901	4,242
220001	Langley Water District	403	1,088
220002	College Acres Public Water District	527	1,350
220003	Bath Water District	314	1,064
220004	Beech Island	2,890	7,436
220005	Talatha Water District	569	1,553
220006	Breezy Hill Water District	4,506	10,861
220008	Montmorenci Water District	1,150	2,940
220012	Valley Public Service Authority	2,765	5,897
310001	Allendale	1,540	4,052
610001	Barnwell	2,121	5,035
610002	Williston	1,620	3,307
610003	Blackville	1,082	3,166
610004	Hilda	131	336
610005	Elko	148	462
210003R	North Augusta Raw Water	10,747	25,581
720003R	Beaufort-Jasper Raw Water	31,304	71,706
SAVR	City of Savannah Raw Water (Industrial)	35	10,619
	TOTAL	81,603	202,318
	Approx. Groundwater	39,517	94,412
	Approx. Surfacewater	42,086	107,906

2.2.4 Data
Drinking Water Quality Monitoring Data

Drinking Water Quality Monitoring
Ground Water Systems

System Number:			0210001				0210002			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	1.82	NS	<3.14	9.77	NS	NS	7.99
	±2	(sigma)		1.18			2.03			2.36
	N-V Beta	(pCi/L)	NS	<2.54	NS	<2.63	<2.49	NS	NS	<2.62
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	NS	399	NS	NS	307
	±2	(sigma)					101			95
	Cesium-137	(pCi/L)	NS	<1.971	NS	<3.257	<3.667	NS	NS	<3.272
	±2	(sigma)								

System Number:			0210003				0210007			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	<1.50	NS	NS	<3.00	2.17	NS	NS	<2.65
	±2	(sigma)					1.09			
	N-V Beta	(pCi/L)	<2.52	NS	NS	<2.62	<2.46	NS	NS	<2.60
	±2	(sigma)								
	Tritium	(pCi/L)	<202	NS	NS	<202	<202	NS	NS	283
	±2	(sigma)								94
	Cesium-137	(pCi/L)	<3.286	NS	NS	<3.518	<3.883	NS	NS	<3.324
	±2	(sigma)								

System Number:			0220001				0220002			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	<1.35	NS	<2.66	2.00	NS	NS	<3.25
	±2	(sigma)					1.16			
	N-V Beta	(pCi/L)	NS	<2.47	NS	<2.60	<2.51	NS	NS	<2.63
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	<196	<202	NS	NS	233
	±2	(sigma)								92
	Cesium-137	(pCi/L)	NS	<2.046	NS	<3.454	<3.786	NS	NS	<3.311
	±2	(sigma)								

System Number:			0220003				0220004			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	<1.46	NS	<3.53	<1.65	NS	NS	<3.18
	±2	(sigma)								
	N-V Beta	(pCi/L)	NS	<2.50	NS	<2.65	<2.55	NS	NS	<2.63
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	<196	<202	NS	NS	213
	±2	(sigma)								91
	Cesium-137	(pCi/L)	NS	<1.697	NS	<3.389	<3.733	NS	NS	<3.284
	±2	(sigma)								

Drinking Water Quality Monitoring
Ground Water Systems

System Number:			**0220005**				**0220006**			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	<1.47	NS	NS	<3.05	<1.45	NS	NS	<3.83
	±2	(sigma)								
	N-V Beta	(pCi/L)	<2.51	NS	NS	<2.62	<2.50	NS	NS	<2.66
	±2	(sigma)								
	Tritium	(pCi/L)	329	NS	NS	503	<202	NS	NS	<202
	±2	(sigma)	98			103				
	Cesium-137	(pCi/L)	<3.990	NS	NS	<3.482	<3.374	NS	NS	<2.958
	±2	(sigma)								

System Number:			**0220008**				**0220012**			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	NS	NS	<3.06	NS	<2.55	NS	<5.98
	±2	(sigma)								
	N-V Beta	(pCi/L)	NS	NS	NS	<2.63	NS	<2.64	NS	<2.73
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	<196	NS	NS	NS	<196
	±2	(sigma)								
	Cesium-137	(pCi/L)	NS	NS	NS	<3.251	NS	<1.909	NS	<3.430
	±2	(sigma)								

System Number:			**0310001**				**0610001**			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	<2.66	NS	NS	<5.14	<1.74	NS	NS	<3.36
	±2	(sigma)								
	N-V Beta	(pCi/L)	<2.63	NS	NS	<2.71	<2.57	NS	NS	<2.64
	±2	(sigma)								
	Tritium	(pCi/L)	<202	NS	NS	<196	<202	NS	NS	<196
	±2	(sigma)								
	Cesium-137	(pCi/L)	<3.404	NS	NS	<3.223	<3.943	NS	NS	<3.405
	±2	(sigma)								

System Number:			**0610002**				**0610003**			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	NS	NS	<3.33	<2.46	NS	NS	<4.87
	±2	(sigma)								
	N-V Beta	(pCi/L)	NS	NS	NS	<2.64	<2.64	NS	NS	<2.70
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	<196	<202	NS	NS	<196
	±2	(sigma)								
	Cesium-137	(pCi/L)	NS	NS	NS	<3.262	<3.580	NS	NS	<3.159
	±2	(sigma)								

Drinking Water Quality Monitoring
Ground Water Systems

System Number:			0610004				0610005			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	<1.54	NS	NS	NS	NS	NS	NS	<3.87
	±2	(sigma)								
	N-V Beta	(pCi/L)	<2.53	NS	NS	NS	NS	NS	NS	<2.66
	±2	(sigma)								
	Tritium	(pCi/L)	<202	NS	NS	NS	NS	NS	NS	<196
	±2	(sigma)								
	Cesium-137	(pCi/L)	<3.821	NS	NS	NS	NS	NS	NS	<3.277
	±2	(sigma)								

System Number:			DWDUP01				DWDUP02			
Date:			1Q04	2Q04	3Q04	4Q04	1Q04	2Q04	3Q04	4Q04
Radionuclides	Gross Alpha	(pCi/L)	NS	NS	NS	NS	NS	NS	NS	NS
	±2	(sigma)								
	N-V Beta	(pCi/L)	NS	NS	NS	NS	NS	NS	NS	NS
	±2	(sigma)								
	Tritium	(pCi/L)	NS	NS	NS	NS	NS	NS	NS	NS
	±2	(sigma)								
	Iodine-131	(pCi/L)	NS	NS	NS	*	NS	NS	NS	*
	±2	(sigma)								
	Cesium-137	(pCi/L)	NS	NS	NS	<3.331	NS	NS	NS	<3.113
	±2	(sigma)								
	Radium-226	(pCi/L)	NS	NS	NS	<1.030	NS	NS	NS	<1.039
	±2	(sigma)								

Drinking Water Quality Monitoring
Surface Water

Sample Number:	0210003R					
Date:			January-04	February-04	March-04	April-04
Radionuclides	Gross Alpha	(pCi/L)	<2.29	<2.33	<LLD	<1.43
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.48	<2.48	<LLD	<2.50
	±2	(sigma)				
	Tritium	(pCi/L)	<184	<184	<200	<200
	±2	(sigma)				
	Cesium-137	(pCi/L)	<1.994	<1.877	<2.745	<2.991
	±2	(sigma)				
Sample Number:	0210003R					
Date:			May-04	June-04	July-04	August-04
Radionuclides	Gross Alpha	(pCi/L)	<1.67	<1.71	NS	NS
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.52	<2.53	NS	NS
	±2	(sigma)				
	Tritium	(pCi/L)	<187	215	NS	NS
	±2	(sigma)		88		
	Cesium-137	(pCi/L)	<3.23	<3.397	NS	NS
	±2	(sigma)				
Sample Number:	0210003R					
Date:			September-04	October-04	November-04	December-04
Radionuclides	Gross Alpha	(pCi/L)	<2.15	<2.05	<2.11	<2.08
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.85	<2.84	<2.85	<2.84
	±2	(sigma)				
	Tritium	(pCi/L)	<202	275	<202	<202
	±2	(sigma)		96		
	Cesium-137	(pCi/L)	<1.990	<1.919	<2.089	<1.991
	±2	(sigma)				

Drinking Water Quality Monitoring
Surface Water

Sample Number: 0720003R						
Date:			January-04	February-04	March-04	April-04
Radionuclides	Gross Alpha	(pCi/L)	<2.44	<2.50	<LLD	<1.66
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.50	<2.50	<LLD	<2.56
	±2	(sigma)				
	Tritium	(pCi/L)	774	965	609	936
	±2	(sigma)	109	115	116	128
	Cesium-137	(pCi/L)	<1.895	<1.928	<2.991	<2.844
	±2	(sigma)				
Sample Number:	**0720003R**					
Date:			May-04	June-04	July-04	August-04
Radionuclides	Gross Alpha	(pCi/L)	<1.97	<2.90	<2.88	<2.95
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.59	<2.96	<2.96	<2.97
	±2	(sigma)				
	Tritium	(pCi/L)	615	498	280	382
	±2	(sigma)	103	101	93	97
	Cesium-137	(pCi/L)	<3.406	<3.466	<3.559	<3.377
	±2	(sigma)				
Sample Number:	0720003R					
Date:			September-04	October-04	November-04	December-04
Radionuclides	Gross Alpha	(pCi/L)	<2.71	<2.59	<2.67	<2.51
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.88	<2.87	<2.88	<2.87
	±2	(sigma)				
	Tritium	(pCi/L)	623	423	485	353
	±2	(sigma)	110	103	105	100
	Cesium-137	(pCi/L)	<2.162	<2.056	<2.057	<2.194
	±2	(sigma)				

Drinking Water Quality Monitoring
Surface Water

Sample Number:	SAVR					
Date:			January-04	February-04	March-04	April-04
Radionuclides	Gross Alpha	(pCi/L)	NS	NS	NS	NS
	±2	(sigma)				
	N-V Beta	(pCi/L)	NS	NS	NS	NS
	±2	(sigma)				
	Tritium	(pCi/L)	NS	NS	NS	NS
	±2	(sigma)				
	Cesium-137	(pCi/L)	NS	NS	NS	NS
	±2	(sigma)				
Sample Number:	SAVR					
Date:			May-04	June-04	July-04	August-04
Radionuclides	Gross Alpha	(pCi/L)	NS	<1.85	NS	<2.82
	±2	(sigma)				
	N-V Beta	(pCi/L)	NS	<2.57	NS	<2.96
	±2	(sigma)				
	Tritium	(pCi/L)	NS	360	NS	436
	±2	(sigma)		94		99
	Cesium-137	(pCi/L)	NS	<3.430	NS	<3.433
	±2	(sigma)				
Sample Number:	SAVR					
Date:			September-04	October-04	November-04	December-04
Radionuclides	Gross Alpha	(pCi/L)	<2.34	<2.45	2.97	<2.13
	±2	(sigma)			1.68	
	N-V Beta	(pCi/L)	<2.86	<2.87	<2.87	<2.67
	±2	(sigma)				
	Tritium	(pCi/L)	390	302	511	NS
	±2	(sigma)	102	98	105	
	Cesium-137	(pCi/L)	<2.082	<2.156	<1.999	<3.227
	±2	(sigma)				

Drinking Water Quality Monitoring
Tritium Data

SAVR- City of Savannah					
	Tritium	±2	Approximate	Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-04	NS	NS	5.957E+11	NS	NS
February-04	NS	NS	7.219E+11	NS	NS
March-04	NS	NS	6.539E+11	NS	NS
April-04	NS	NS	3.940E+11	NS	NS
May-04	NS	NS	4.210E+11	NS	NS
June-04	360	94	4.730E+11	170.28	44.46
July-04	NS	NS	4.729E+11	NS	NS
August-04	436	99.00	4.464E+11	194.61	44.19
September-04	390	102.00	9.261E+11	361.17	94.46
October-04	302	102.00	1.046E+12	315.93	106.70
November-04	511	105.00	5.744E+11	293.50	60.31
December-04	NS	NS	1.031E+12	NS	NS
Mean	360.00		6.46E+11	170.28	Ci/month
Estimated Annual				2043	Ci/year

0210003R- North Augusta					
	Tritium	±2	Approximate	Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-04	<184	0	5.957E+11	<LLD	<LLD
February-04	<184	0	7.219E+11	<LLD	<LLD
March-04	<200	0	6.539E+11	<LLD	<LLD
April-04	<200	0	3.940E+11	<LLD	<LLD
May-04	<187	0	4.210E+11	<LLD	<LLD
June-04	215	88	4.730E+11	101.69	41.62
July-04	NS	0	4.729E+11	NS	NS
August-04	NS	0	4.464E+11	NS	NS
September-04	<202	0	9.261E+11	<LLD	<LLD
October-04	275	96	1.046E+12	287.68	100.43
November-04	<202	0	5.744E+11	<LLD	<LLD
December-04	<202	0	1.031E+12	<LLD	<LLD
Mean	245.00		6.46E+11	194.69	Ci/month
Estimated Annual				2336	Ci/year

0720003R- Beafort-Jasper					
	Tritium	±2		Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-04	774	109	5.957E+11	461.06	64.93
February-04	965	115	7.219E+11	696.68	83.02
March-04	609	116	6.539E+11	398.25	75.86
April-04	936	128	3.940E+11	368.81	50.44
May-04	615	103	4.210E+11	258.94	43.37
June-04	498	101	4.730E+11	235.55	47.77
July-04	280	93	4.729E+11	132.41	43.98
August-04	382	97	4.464E+11	170.51	43.30
September-04	623	110	9.261E+11	576.94	101.87
October-04	423	103	1.046E+12	442.51	107.75
November-04	485	105	5.744E+11	278.57	60.31
December-04	353	100	1.031E+12	363.83	103.07
Mean	578.58		6.46E+11	365.47	Ci/month
Estimated Annual				4386	Ci/year

2.2.5 Summary Statistics
Drinking Water Quality Monitoring

Radionuclide:		Gross Alpha (pCi/L)				
Statistical Analysis:		Maximum	Minimum	Median	Mean	Std. Dev.
System Number:	**0210001**	1.82	1.82	1.82	1.82	0
	0210002	9.77	7.99	8.88	8.88	1.26
	0220002	2	2	2.00	2.00	0.00
	0210007	2.17	2.17	2.17	2.17	0
yearly mean of detectable gross alpha					3.72	
standard deviation					3.44	

Radionuclide:		Tritium (pCi/L)				
Statistical Analysis:		Max	Min	Median	Mean	Std. Dev.
System Number:	**0220005**	503	329	416	416	123.04
	0210002	399	307	353	353	65.05
	0210007	283	283	283	283	0
	0220002	233	233	233	233	0
	0220004	213	213	213	213	0
yearly mean of detectable tritium					300	
standard deviation					85	

Ground Water

Surface Water

Radionuclide:		Gross Alpha (pCi/L)				
Statistical Analysis:		Max	Min	Median	Mean	Std. Deviation
System Number:	**0210003R**	<LLD	<LLD	<LLD	<LLD	<LLD
	0720003R	<LLD	<LLD	<LLD	<LLD	<LLD
	SAVR	2.97	2.97	2.97	2.97	<LLD
yearly mean of detectable gross alpha					2.97	
standard deviation					0.00	

Radionuclide:		Tritium (pCi/L)				
Statistical Analysis:		Max	Min	Median	Mean	Std. Deviation
System Number:	**0210003R**	275	215	245	245	42.43
	0720003R	965	280	553.5	579	221
	SAVR	511	302	390	400	79
yearly mean of detectable tritium					408	
standard deviation					167	

2.3 Radiological Surface Water and Sediment Surveillance

2.3.1 Summary

Surface water bodies on and adjacent to the Savannah River Site (SRS) continue to be the focus for monitoring and surveillance activities of the Environmental Surveillance and Oversight Program (ESOP), Radiological Surface Water and Sediment (RSW&S) Project. Accordingly, surface water and sediment samples were collected and analyzed for radionuclides, the results from which were compared to SRS data. In addition, project databases were expanded, and trends of radionuclides in streams and sediments were characterized. These activities will allow the project to generate independent data that can be shared with the public.

The gathering of data is possible through the collection of surface water from specific sample locations within and external to the perimeter of the SRS (Map 5, section 2.3.2). Automatic sampling devices were used at seven (7) locations, identified as "enhanced" sampling locations, where water was collected three days per week. These samples were analyzed for tritium and composited into station-specific monthly samples that were analyzed for gross alpha, gross beta, and gamma-emitting radionuclides. Water from six (6) additional sampling locations, called "ambient" locations, are collected once a week and analyzed for tritium. Stream water emanating from the SRS was also collected once a month from five (5) creek mouths at their confluence with the Savannah River. These river locations were monitored for tritium.

The enhanced surface water-monitoring program is intended to provide downstream drinking water customers with advance notice of the potential for increased tritium levels in the Savannah River as the result of a SRS release. This early detection facet is possible because of the continuous monitoring of six SRS streams that flow to the Savannah River. ISCO® automatic samplers collect 30 to 50 milliliters (ml) of stream water every 30 minutes. ESOP personnel collected these composite samples every Monday, Wednesday, and Friday. Samples were analyzed for tritium on the day of collection by the South Carolina Department of Health & Environmental Control (SCDHEC)/Region 5 Environmental Quality Control laboratory. Results from the tritium analysis were used to project tritium activity in the Savannah River. There were no releases above expected activities.

RESULTS AND DISCUSSION

Surface Water

A summary of surface water data for each location is located in section 2.3.4.

Tritium

Samples from SRS streams and the Savannah River were analyzed for tritium activity. Four Mile Creek receives effluent from F-Area, H-Area, and the Central Sanitary Wastewater Treatment Facility (CSWTF); storm water runoff from E-Area, C-Area, F-Area, and H-Area; and leachate from seepage basins and the Old Radioactive Waste Burial Ground (ORWBG) (WSRC 2001). Pen Branch receives discharges and storm water runoff from K-Area. Most of the tritium in Pen Branch is attributed to groundwater seepage from K-Area. Upper Three Runs had the most varied activities of tritium (691-11,269 pCi/L). Upper Three Runs receives discharges from the Effluent Treatment Facility (ETF), which has treated low-level radioactive wastewater since 1994. Storm water runoff from F-Area, H-Area, S-Area, and Z-Area also impact Upper Three Runs by transferring contamination to waterways of the state (WSRC 2001). In addition, groundwater that has migrated from E-Area outcrops into Upper Three Runs (ORWBG FG 2001).

Tritium activities in the Savannah River at the confluences of the five (5) SRS streams were also monitored on a monthly basis. The streams sampled were Upper Three Runs (2,507 pCi/L), Beaver Dam Creek (817 pCi/L), Steel Creek (7,483 pCi/L), and Lower Three Runs (955 pCi/L). Three samples were collected each time at Four Mile Creek, one from the creek mouth (55,105 pCi/L), one from 30 feet downstream of the creek mouth (36,223 pCi/L), and one from 150 feet downstream of the creek mouth (16,324 pCi/L). Samples were taken at these three intervals in order to show the effect of the mixing zone created by the Savannah River flow.

The mean tritium activity at all five colocated sampling sites (Table 1, section 2.3.3) were reported without subtracting background values. 1) Upper Three Runs: 3,969 pCi/L, Standard Deviation (SD) 2,728.9 (ESOP)/ 4,030 pCi/L (DOE-SR); 2) Four Mile Creek: 71,598 pCi/L, SD 11,031 (ESOP)/ 77,500 pCi/L (DOE-SR); 3) Steel Creek: 3,483 pCi/L, SD 711.1 (ESOP)/ 3,950 pCi/L (DOE-SR); 4) Lower Three Runs: 566 pCi/L, SD 163.8 (ESOP)/ 700 pCi/L (DOE-SR); 5) Highway 301 Bridge: 616 pCi/L, SD 358.9 (ESOP)/ 661 pCi/L (DOE-SR). All ESOP results were within one standard deviation of those reported by DOE-SR.

Cesium (Gamma-emitter)

Cesium was not found (undetected) in any surface water sample above the ESOP MDA.

Gross Alpha

Alpha-emitting radionuclide activity was detected at all nine locations where monthly composite samples were collected. Activity ranged from 1.25 pCi/L to 5.80 pCi/L, with the highest value at Upper Three Runs (SV-325). At colocated sampling points (Page C-2), ESOP results were within one SD of DOE-SR results at Upper Three Runs and Steel Creek, within three SD at Highway 301 Bridge, and four SD at Four Mile Creek.

Gross Beta

Beta-emitting radionuclide activity was detected in seven out of nine locations where monthly composite samples were collected in 2004. The activity ranged from 2.66 pCi/L to 8.68 pCi/L, with Four Mile Creek recording the highest activity. At collocated sampling points (Page C-2), ESOP results were within one SD of DOE-SR results at Upper Three Runs, Lower Three Runs, and Highway 301 Bridge, and within three SD at Four Mile Creek.

Sediment

Six (6) sites had colocated sediment samples: Upper Three Runs, Beaver Dam Creek, Steel Creek, Lower Three Runs, Lower Three Runs creek mouth, and Highway 301 Bridge. Cesium-137 activity was detected in 13 of the 18 sediment samples collected. The activity ranged from 0.035 to 2.73 picocuries per gram (pCi/g). The highest level of Cs-137 in sediment was detected from Four Mile Creek. The results from samples collected at Jackson Landing, Beaver Dam Creek and creek mouth, Pen Branch and Upper Three Runs creek mouth were below the SCDHEC MDA.

Sediment samples were sent to Severn Trent Laboratories (STL) Richland to be analyzed for Pu-238, Pu-239/240, and Tc-99. No results were recorded above the MDA (section 2.3.4).

DOE-SR / ESOP DATA COMPARISON

Surface Water

Data reported in this project was compared to DOE-SR reported results (WSRC 2005). Data comparisons are located in tables1-4 in section 2.3.3. ESOP and DOE-SR colocated sampling sites were Upper Three Runs, Four Mile Creek, Pen Branch, Steel Creek, Steel Creek Landing, Lower Three Runs, and Highway 301 Bridge.

Tritium activities for all colocated sites were within one SD. The 2004 ESOP and DOE-SR tritium results appear to be consistent with historically reported data values (SCDHEC 1999 - 2003, WSRC 1998 – 2001, 2002-2004). Mean tritium activity in upstream (background) locations, Jackson Boat Landing and Upper Three Runs, was lower than mean tritium activity at the enhanced and ambient sample locations. Four Mile Creek (SV-2039) and Pen Branch (SV-2047) continued to have the highest levels of tritium activity. Four Mile Creek receives effluent from F-Area, H-Area, and the CSWTF; storm water runoff from E-Area, C-Area, F-Area, and H-Area; and leachate from seepage basins and the ORWBG (WSRC 2001). However, since the beginning of the phytoremediation project at Four Mile Creek, tritium levels have decreased. Pen Branch receives discharges and storm water runoff from K-Area. Most of the tritium in Pen Branch is attributed to groundwater seepage (WSRC 2001). Due to historical and current activities in these Areas, these streams will continue to exhibit higher activities of tritium in relation to other sample locations. Upper Three Runs (SV-325) continues to display the most variation in tritium activity. This is a consequence of receiving discharges from the ETF upstream of this location. ETF treats wastewater with low levels of radioactive contaminants (WSRC 2000).

ESOP detected gross alpha activity at all of the colocated sample locations and gross beta activity in four of the six sampling locations. A comparison of ESOP and DOE-SR data reveal variations in the analytical results. There were also increases in values between 2003 and 2004 ESOP data. Upper Three Runs again exhibited the highest alpha activity in 2004. Greater variation was seen between results of gross alpha activity for colocated sites because activity levels in environmental samples were at very low levels, i.e., close to or below MDA. ESOP utilizes MDA in reporting radioactivity and does not report anything below MDA. DOE-SR, however, incorporates all values, including negative numbers (those values below the instruments minimum detectiblility). This approach accounts for seemingly large differences between mean values. Also, differences can be attributed, in part, to the nature of the water medium and the specific point and time when the sample is collected.

The highest levels of beta-emitting radionuclide activity were detected in Four Mile Creek. These levels were potentially due to the groundwater contamination from the ORWBG and the former seepage basins located in F-Area and H-Area (WSRC 2000).

ESOP did not detect Cs-137 activity at any of the colocated sampling points. DOE-SR reported cesium at all six sample locations, with the highest mean value found at Lower Three Runs creek (1.89 pCi/L)(WSRC 2005).

Sediment

Data variations were also observed between ESOP and DOE-SR sediment sample results. Data comparisons were found in tables1-4 in section 2.3.3. A sediment sample collected by ESOP from Four Mile Creek (SV-2039) exhibited the greatest Cs -137 activity (2.733 pCi/g). Samples collected from similar stream sites exhibited variability between ESOP and DOE-SR analytical results. Other than the variability in the number of samples analyzed, discrepancies among data results may be attributed to differences in laboratory methodology, field procedures, and/or sample size.

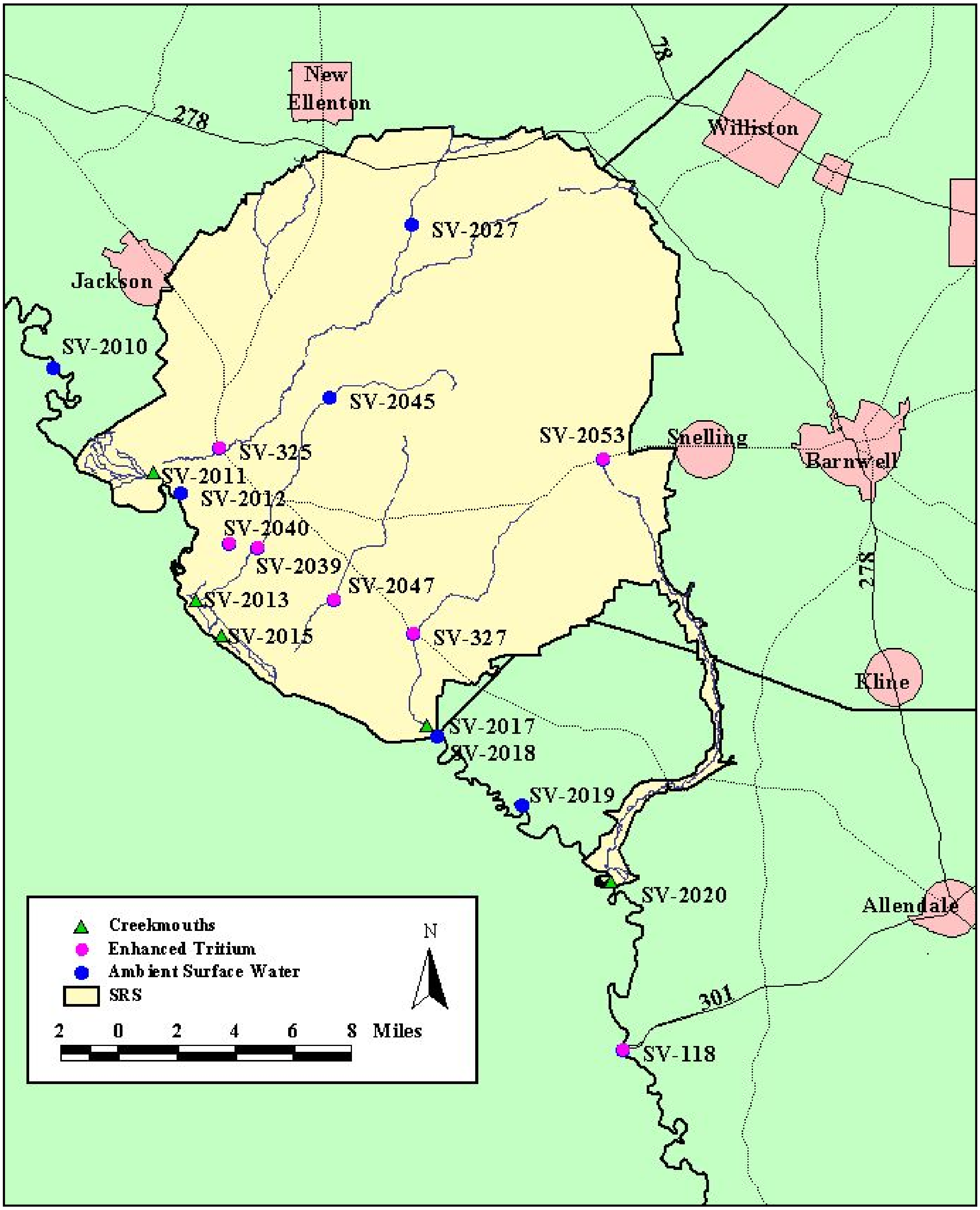
CONCLUSIONS AND RECOMMENDATIONS

All results for the public access locations downstream from SRS were below the EPA tritium MCL of 20,000 pCi/L for drinking water. However, data generated from samples collected at the mouth of Four Mile Creek indicate that the public could come into contact with tritium activity greater than the MCL at that location.

Analytical results for tritium activity at sampling sites colocated with DOE-SR were within one SD. Also, a comparison of gross alpha and beta data identified results within one to four SD and one to three SD, respectively.

ESOP will continue independent monitoring of surface water and sediment and will periodically evaluate modification of the monitoring activities to better accomplish the project's goals and objectives. Monitoring will continue as long as there were activities at the SRS that create the potential for contamination entering the environment. Continued monitoring will provide an improved understanding of radionuclide activity in SRS surface waters and the Savannah River, and impart valuable information to human health exposure pathways. The comparison of data results allows for independent data verification of DOE-SR. Cooperation between DOE-SR and ESOP is a means of providing credibility and confidence in the information being provided to the public.

2.3.2
Map 5. Radiological Surface Water and Sediment Surveillance



2.3.3 Tables and Figures
Radiological Surface Water and Sediment Surveillance

Table 1. Surface Water Tritium Detection Data.

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Mean Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	181	317	201	49	7
Upper Three Runs (SV-2027)	192	460	265	52	40
Upper Three Runs (SV-325)	691	11,269	3,969	52	52
U3R at Road A*	770	11,100	4,030	12	NR
Upper Three Runs (SV-2011) Creek Mouth	217	16,159	2,507	11	11
TNX Boat Landing (SV-2012)	188	1,558	320	52	33
Beaver Dam Creek (SV-2040)	266	822	460	50	50
Beaver Dam Creek (SV-2013) Creek Mouth	192	2,863	760	11	10
Four Mile Creek (SV-2039)	44,176	93,145	71,598	52	52
FM-6 Road A-12.2*	58,600	95,400	77,500	12	NR
Four Mile Creek (SV-2045)	30,697	199,458	139,568	52	52
Four Mile Creek (SV-2015) Creek Mouth	199	88,718	55,105	11	11
Four Mile Creek (SV-2015) 30' downstream from creek mouth	187	78,738	23,121	11	7
Four Mile Creek (SV-2015) 150' downstream from creek mouth	192	56,009	16,341	11	10
Pen Branch (SV-2047)	28,493	86,213	64,085	52	52
PB-3 at Road 13.2*	40,800	86,200	69,900	12	NR
Steel Creek (SV-327)	2,281	5,401	3,483	52	52
SC-4 Steel Creek at Road A*	2,680	5,000	3,950	12	NR
Steel Creek (SV-2017) Creek Mouth	192	19,683	7,499	11	10
Steel Creek Boat Landing (SV-2018)	190	11,541	1,274	52	46
Steel Creek Boat Ramp River Mile 141.5	139	1,860	761	52	NR
Lower Three Runs (SV-2053)	326	1,253	566	52	52
L3R-1A at Road B*	261	1,540	700	12	NR
Lower Three Runs (SV-2020) Creek Mouth	218	1,815	955	11	11
Little Hell Landing (SV-2019)	190	5,269	624	52	50
Highway 301 Bridge (SV-118)	203	1,825	616	52	52
River Mile 118.8*	64	1,960	661	52	NR

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2004
(2) Bold and italicized entries represent colocated sampling stations.
(3) NR: Not Reported
(4) Conc. = Concentration

Tables and Figures
Radiological Surface Water and Sediment Surveillance

Table 2. Surface Water Gross Alpha Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Mean Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	ND	2.12	2.12	12	1
Upper Three Runs (SV-325)	2.24	5.80	3.71	12	10
U3R-4 at Road A*	1.33	5.76	2.57	12	NR
Beaver Dam Creek (SV-2040)	1.25	3.80	2.56	12	4
Four Mile Creek (SV-2039)	1.52	2.05	1.78	12	2
FM-6 Road A-12.2*	-0.719	1.87	0.56	12	NR
Pen Branch (SV-2047)	ND	1.89	1.89	12	1
PB-3 at Road 13.2*	0.10	1.32	0.659	12	NR
Steel Creek (SV-327)	2.05	3.71	2.60	12	4
SC-4 Steel Creek at Road A*	0.192	11.90	2.08	12	NR
Steel Creek Boat Landing (SV-2018)	ND	1.25	1.25	12	1
Lower Three Runs (SV-2053)	ND	2.27	2.27	12	1
L3R-1A at Road B*	-0.152	2.00	0.755	12	NR
Highway 301 Bridge (SV-118)	1.49	2.26	1.87	12	2
River Mile 118.8*	-2.51	1.69	0.481	52	NR

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2004.
(2) Bold and italicized entries represent colocated sampling stations for both organizations.
(3) NR = Sample results not reported.
(4) Conc. = Concentration
(5) ND = None Detected.

Tables and Figures
Radiological Surface Water and Sediment Surveillance

Table 3. Surface Water Gross Beta Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Mean Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	3.73	7.06	5.30	12	3
Upper Three Runs (SV-325)	2.67	5.13	3.90	12	2
U3R-4 at Road A*	0.811	3.73	1.76	12	NR
Beaver Dam Creek (SV-2040)	3.93	4.28	4.11	12	2
Four Mile Creek (SV-2039)	4.15	8.68	6.44	12	12
FM-6 Road A-12.2*	8.86	13.20	10.90	12	NR
Pen Branch (SV-2047)	ND	ND	ND	12	0
PB-3 at Road 13.2*	0.951	3.51	1.70	12	NR
Steel Creek (SV-327)	ND	ND	ND	12	0
SC-4 Steel Creek at Road A*	0.139	8.57	2.86	12	NR
Steel Creek Boat Landing (SV-2018)	2.50	2.80	2.65	12	1
Lower Three Runs (SV-2053)	2.65	4.19	3.18	12	4
L3R-1A at Road B*	-4.76	5.57	2.88	12	NR
Highway 301 Bridge (SV-118)	2.66	4.73	3.69	12	2
River Mile 118.8*	1.38	4.46	2.88	52	NR

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2004.
(2) Bold and italicized entries represent colocated sampling stations for both organizations.
(3) NR = Sample results not reported.
(4) Conc. = Concentration
(5) ND = None Detected.

Tables and Figures
Radiological Surface Water and Sediment Surveillance

Table 4. Surface Water Cs-137 Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Mean Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	ND	ND	ND	12	0
Upper Three Runs (SV-325)	ND	ND	ND	12	0
U3R at Road A*	-2.62	4.81	1.10	12	NR
Beaver Dam Creek (SV-2040)	ND	ND	ND	12	0
Four Mile Creek (SV-2039)	ND	ND	ND	12	0
FM-6 Road A-12.2*	-2.38	5.81	1.52	12	NR
Pen Branch (SV-2047)	ND	ND	ND	12	0
PB-3 at Road A-13.2*	-4.76	2.69	-0.56	12	NR
Steel Creek (SV-327)	ND	ND	ND	12	0
SC-4 Steel Creek at Road A*	-7.57	4.08	-0.402	12	NR
Steel Creek Boat Landing (SV-2018)	ND	ND	ND	12	0
Lower Three Runs (SV-2053)	ND	ND	ND	12	0
L3R-1A at Road B*	-0.95	7.4	1.89	12	NR
Highway 301 Bridge (SV-118)	ND	ND	ND	12	0
River Mile 118.8*	-0.781	3.46	0.131	12	NR

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2004
(2) Bold and italicized entries represent colocated sampling stations for both organizations
(3) NR = Sample results not reported.
(4) N/A: Not Applicable
(5) ND = None Detected.

Tables and Figures
Radiological Surface Water and Sediment Surveillance

Table 5. Sediment Detection Data

Sample Location	Cs-137 (pCi/g)
Jackson Landing (SV-2010)	ND
Four Mile Creek (SV-2045)	1.143
Upper Three Runs (SV-325)	0.106
Upper Three Runs (SV-2027)	0.147
TNX Boat Landing (SV-2012)	0.036
Beaver Dam Creek (SV-2040)	ND
Four Mile Creek (SV-2039)	2.733
Pen Branch (SV-2047)	ND
Steel Creek (SV-327)	0.376
SC-4 Steel Creek at Road A*	0.554
Steel Creek Boat Landing (SV-2018)	0.421
Lower Three Runs (SV-2053)	0.218
L3R-1A at Road B*	0.430
Highway 301 Bridge (SV-118)	0.145
River Mile 118.8*	0.273
Little Hell Landing (SV-2019)	0.035
Lower Three Runs (SV-2020)	1.244
Lower 3 Runs Mouth*	0.435
Upper Three Runs (SV-2011)	ND
Upper 3 Runs Creek Mouth*	-0.005
Beaver Dam Creek (SV-2013)	ND
Beaver Dam Creek Mouth*	0.0076
Four Mile Creek (SV-2015)	0.291
Steel Creek (SV-2017)	0.960

Notes:
(1) *WSRC data from the SRS Environmental Data Report fo
(2) Bold and italicized entries represent colocated sampling st
(3) ND: Not Detected

2.3.4 Data
Radiological Surface Water and Sediment Monitoring On and Adjacent to the Savannah River Site

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Jackson Boat Landing (SV-2010)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	2.12	1.06	1.0	<MDA		2.63	<MDA		1.89
01/07/04	<200										
01/14/04	<202										
01/21/04	<192										
01/28/04	NS		<MDA		2.52	<MDA		2.51	<MDA		1.83
02/04/04	317	124									
02/11/04	187	138									
02/18/04	<193										
02/25/04	NS	NS	<MDA		1.93	<MDA		2.73	<MDA		1.97
03/03/04	224	88									
03/10/04	216	89									
03/17/04	<192										
03/24/04	<184										
03/31/04	293	91	<MDA		1.65	<MDA		2.23	<MDA		1.97
04/07/04	<195										
04/14/04	<195										
04/21/04	<184										
04/28/04	<193		<MDA		1.71	<MDA		3.07	<MDA		2.25
05/05/04	<194										
05/12/04	<198										
05/19/04	<191										
05/26/04	<201		<MDA		1.66	7.06	1.91	3.06	<MDA		3.48
06/02/04	<192										
06/09/04	269	91									
06/16/04	<195										
06/23/04	<181										
06/30/04	<191		<MDA		1.79	<MDA		2.55	<MDA		3.63
07/07/04	<195										
07/14/04	<189*										
07/21/04	<190										
07/28/04	199	84	<MDA		2.64	<MDA		2.93	<MDA		2.08
08/04/04	<187										
08/11/04	<189										
08/18/04	<187										
08/25/04	<192										
09/01/04	<199		<MDA		2.78	<MDA		2.62	<MDA		3.47
09/08/04	<193										
09/15/04	<190										
09/22/04	<199										
09/29/04	<196		<MDA		2.26	5.10	1.55	2.37	<MDA		3.33
10/06/04	<199										
10/13/04	<195										
10/20/04	<203										
10/27/04	<195		<MDA		2.41	3.73	1.72	3.00	<MDA		3.58
11/03/04	<193										
11/12/04	<196										
11/17/04	<197										
11/24/04	<190		<MDA		1.86	<MDA		2.97	<MDA		3.16
12/01/04	<188										
12/08/04	<199										
12/15/04	<195										
12/22/04	<191										
12/29/04	<197										
N =	7		1			3			0		
Max. =	317		2.12			7.06			ND		
Min. =	ND		2.12			3.73			ND		
Mean =	244		2.12			5.30			ND		
Median =	224		2.12			5.10			ND		
Std. Dev.=	49.69		N/A			1.67			ND		

*Results could not be verified or validated.
NR = Not Reported.
NS = No Sample Collected.
ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Fourmile Branch @ Road C-7 (SV-2045)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/07/04	164055	2746
01/14/04	199458	1923
01/21/04	164839	1735
01/28/04	131015	1540
02/04/04	183098	2069
02/11/04	187829	2984
02/18/04	142464	2554
02/25/04	178840	2905
03/03/04	101646	886
03/10/04	131712	1012
03/17/04	148250	2610
03/24/04	141544	2539
03/31/04	138606	1040
04/07/04	137798	1037
04/14/04	158998	1116
04/21/04	149636	1075
04/28/04	143299	1063
05/05/04	118556	967
05/12/04	154550	1101
05/19/04	122010	984
05/26/04	146846	1073
06/02/04	146338	1071
06/09/04	102434	898
06/16/04	136001	1031
06/23/04	110793	937
06/30/04	102446	897
07/07/04	148586	1351
07/14/04	145220*	1083
07/21/04	150578	1084
07/28/04	137108	1032
08/04/04	158926	1116
08/11/04	112618	940
08/18/04	119492	968
08/25/04	115287	952
09/01/04	108218	926
09/08/04	30697	501
09/15/04	107647	921
09/22/04	111294	937
09/29/04	87305	830
10/06/04	135125	1031
10/13/04	137721	1042
10/20/04	147919	1075
10/27/04	163022	1134
11/03/04	141794	1056
11/12/04	151562	1088
11/17/04	179903	1186
11/24/04	86311	830
12/01/04	168947	1149
12/08/04	182691	1192
12/15/04	141655	1051
12/22/04	177588	1175
12/29/04	172926	1162
N =	51	
Max. =	199458	
Min. =	30697	
Mean =	139568	
Median =	141794	
Std. Dev.=	30869.94	

*Results could not be verified or validated.

Sample Location: SRS TNX Boat Landing (SV-2012)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/07/04	<200	
01/14/04	269	122
01/21/04	213	114
01/28/04	307	120
02/04/04	318	124
02/11/04	460	160
02/18/04	831	195
02/25/04	1558	239
03/03/04	472	98
03/10/04	210	89
03/17/04	<193	
03/24/04	326	152
03/31/04	561	101
04/07/04	305	95
04/14/04	467	101
04/21/04	416	95
04/28/04	454	100
05/05/04	<194	
05/12/04	<198	
05/19/04	333	95
05/26/04	<201	
06/02/04	200	90
06/09/04	389	97
06/16/04	290	95
06/23/04	313	90
06/30/04	294	93
07/07/04	<195	
07/14/04	<189*	
07/21/04	204	89
07/28/04	335	90
08/04/04	291	92
08/11/04	264	91
08/18/04	308	93
08/25/04	220	91
09/01/04	252	95
09/08/04	<193	
09/15/04	<190	
09/22/04	<199	
09/29/04	<196	
10/06/04	334	98
10/13/04	<195	
10/20/04	<203	
10/27/04	445	101
11/03/04	444	100
11/12/04	456	102
11/17/04	<197	
11/24/04	<190	
12/01/04	<188	
12/08/04	<199	
12/15/04	<195	
12/22/04	<191	
12/29/04	254	94
N =	33	
Max. =	1558	
Min. =	200	
Mean =	388	
Median =	318	
Std. Dev.=	245.35	

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Upper Three Runs @ SC 125 (SV-325)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	3.09	1.15	0.88	<MDA		2.59	<MDA		4.00
01/07/04	3039	316									
01/14/04	11269	426									
01/21/04	2999	229									
01/28/04	2572	215	<MDA		2.18	<MDA		2.46	<MDA		2.04
02/04/04	3059	248									
02/11/04	7636	494									
02/18/04	7090	484									
02/25/04	8892	538	4.41	1.57	1.68	<MDA		2.68	<MDA		1.94
03/03/04	5471	220									
03/10/04	8371	266									
03/17/04	10743	594									
03/24/04	9956	568									
03/31/04	9727	284	5.73	1.65	1.56	2.67	1.33	2.2	<MDA		1.85
04/07/04	8149	264									
04/14/04	3604	185									
04/21/04	5347	217									
04/28/04	4591	205	2.24	1.18	1.46	<MDA		3.01	<MDA		2.22
05/05/04	1916	147									
05/12/04	2144	153									
05/19/04	2985	173									
05/26/04	1598	139	3.80	1.45	1.52	<MDA		3.03	<MDA		3.47
06/02/04	1086	122									
06/09/04	1463	132									
06/16/04	1237	128									
06/23/04	5110	213									
06/30/04	4992	213	3.50	1.37	1.60	<MDA		2.50	<MDA		3.18
07/07/04	2403	186									
07/14/04	1552*	135									
07/21/04	3134	174									
07/28/04	1945	142	<MDA		2.38	<MDA		2.90	<MDA		2.16
08/04/04	3515	183									
08/11/04	4470	202									
08/18/04	3782	189									
08/25/04	2725	166									
09/01/04	1708	143	5.80	1.90	2.44	5.13	1.65	2.60	<MDA		3.49
09/08/04	1886	146									
09/15/04	2352	159									
09/22/04	1085	125									
09/29/04	1469	136	3.46	1.55	1.98	<MDA		2.35	<MDA		3.26
10/06/04	1839	147									
10/13/04	1167	128									
10/20/04	691	112									
10/27/04	1860	146	2.71	1.45	2.09	<MDA		2.98	<MDA		3.14
11/03/04	5279	218									
11/12/04	2946	173									
11/17/04	4318	201									
11/24/04	2758	168	2.32	1.32	1.76	<MDA		2.96	<MDA		3.38
12/01/04	4122	199									
12/08/04	3472	184									
12/15/04	2868	171									
12/22/04	2819	168									
12/29/04	2770	169									
N =	51		10			2			0		
Max. =	11269		5.80			5.13			ND		
Min. =	691		2.24			2.67			ND		
Mean =	3969		3.71			3.90			ND		
Median =	2999		3.48			3.90			ND		
Std. Dev.=	2728.89		1.27			1.74			ND		

*Results could not be verified or validated.

NR = Not Reported.

ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Beaver Dam Creek (SV-2040)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	1.25	0.893	1.03	<MDA		2.64	<MDA		4.00
01/07/04	366	165									
01/14/04	575	138									
01/21/04	603	135									
01/28/04	539	132	<MDA		2.72	<MDA		2.53	<MDA		1.79
02/04/04	577	139									
02/11/04	793	185									
02/18/04	734	188									
02/25/04	558	176	3.16	1.72	2.25	<MDA		2.76	<MDA		1.83
03/03/04	642	103									
03/10/04	NS	NS									
03/17/04	627	179									
03/24/04	812	188									
03/31/04	822	111	<MDA		1.91	<MDA		2.28	<MDA		2.01
04/07/04	738	111									
04/14/04	462	101									
04/21/04	529	100									
04/28/04	434	99	<MDA		2.12	<MDA		3.13	<MDA		1.78
05/05/04	302	95									
05/12/04	343	98									
05/19/04	379	97									
05/26/04	267	96	2.02	1.39	1.92	<MDA		3.11	<MDA		3.65
06/02/04	384	97									
06/09/04	479	100									
06/16/04	415	99									
06/23/04	529	99									
06/30/04	595	105	<MDA		1.88	<MDA		2.57	<MDA		3.99
07/07/04	412	113									
07/14/04	351*	95									
07/21/04	357	95									
07/28/04	459	95	<MDA		2.74	<MDA		2.95	<MDA		2.33
08/04/04	523	101									
08/11/04	526	102									
08/18/04	473	99									
08/25/04	449	100									
09/01/04	295	96	<MDA		2.78	4.28	1.61	2.68	<MDA		3.51
09/08/04	357	97									
09/15/04	407	98									
09/22/04	312	97									
09/29/04	370	98	<MDA		2.61	3.93	1.49	2.39	<MDA		3.35
10/06/04	415	101									
10/13/04	355	97									
10/20/04	318	98									
10/27/04	267	94	<MDA		2.87	<MDA		3.03	<MDA		3.19
11/03/04	266	93									
11/12/04	449	101									
11/17/04	503	104									
11/24/04	283	92	3.80	1.66	1.97	<MDA		2.98	<MDA		3.29
12/01/04	S.E.										
12/08/04	385	100									
12/15/04	302	95									
12/22/04	320	94									
12/29/04	319	97									
N =	49		4			2			0		
Max. =	822		3.80			4.28			ND		
Min. =	266		1.25			3.93			ND		
Mean =	462		2.56			4.11			ND		
Median =	434		2.59			4.11			ND		
Std. Dev.=	149.57		1.14			0.25			ND		

*Results could not be verified or validated.
S.E. = Sample error
NR = Not Reported.
NS = No Sample Collected.
ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Four Mile Creek @ Road A-13 (SV-2039)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	1.52	0.883	0.911	4.97	1.59	2.6	<MDA		4.00
01/07/04	93145	1980									
01/14/04	92804	1275									
01/21/04	93008	1273									
01/28/04	85336	1222	<MDA		2.22	5.30	1.55	2.47	<MDA		1.96
02/04/04	92159	1419									
02/11/04	91736	1975									
02/18/04	76612	1787									
02/25/04	79615	1824	<MDA		1.8	7.26	1.77	2.71	<MDA		1.98
03/03/04	70221	738									
03/10/04	68313	728									
03/17/04	65560	1630									
03/24/04	73227	1738									
03/31/04	72991	753	<MDA		1.59	6.64	1.54	2.21	<MDA		2.09
04/07/04	74238	760									
04/14/04	72936	754									
04/21/04	76751	770									
04/28/04	74146	764	<MDA		1.58	7.22	1.91	3.04	<MDA		2.07
05/05/04	68533	736									
05/12/04	68313	735									
05/19/04	64104	712									
05/26/04	67252	726	<MDA		1.58	5.47	1.82	3.04	<MDA		3.38
06/02/04	67489	727									
06/09/04	86274	846									
06/16/04	56258	663									
06/23/04	59596	683									
06/30/04	60650	689	<MDA		1.69	4.15	1.52	2.52	<MDA		3.69
07/07/04	52810	791									
07/14/04	66350*	719									
07/21/04	63522	701									
07/28/04	61378	690	<MDA		2.44	8.68	1.92	2.91	<MDA		1.75
08/04/04	59656	682									
08/11/04	63988	703									
08/18/04	62116	699									
08/25/04	62583	701									
09/01/04	66708	725	<MDA		2.57	8.12	1.77	2.61	<MDA		3.48
09/08/04	60913	693									
09/15/04	44176	594									
09/22/04	59852	687									
09/29/04	56449	667	<MDA		2.15	7.46	1.67	2.36	<MDA		3.25
10/06/04	63965	709									
10/13/04	74746	764									
10/20/04	71047	747									
10/27/04	75358	769	<MDA		2.25	7.06	1.87	2.99	<MDA		3.32
11/03/04	77582	780									
11/12/04	73000	757									
11/17/04	78851	788									
11/24/04	74260	761	2.05	1.30	1.80	4.92	1.78	2.97	<MDA		3.87
12/01/04	76089	773									
12/08/04	81397	798									
12/15/04	76457	774									
12/22/04	79509	788									
12/29/04	83816	810									
N =	51		2			12			0		
Max. =	93145		2.05			8.68			ND		
Min. =	44176		1.52			4.15			ND		
Mean =	71598		1.78			6.44			ND		
Median =	72936		1.78			6.85			ND		
Std. Dev.=	11031		0.37			1.43			ND		

*Results could not be verified or validated.
NR = Not Reported.
ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Pen Branch @ Road A-13 (SV-2047)												
Date	Tritium		Gross Alpha			Gross Beta			Cs-137			
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	<MDA		0.97	<MDA		2.62	<MDA		4.00
01/07/04	73514	1733									
01/14/04	69406	1094									
01/21/04	73909	1132									
01/28/04	61714	1029	<MDA		2.45	<MDA		2.5	<MDA		1.89
02/04/04	50653	1029									
02/11/04	46758	1347									
02/18/04	30678	1069									
02/25/04	44634	1316	<MDA		1.85	<MDA		2.71	<MDA		2.02
03/03/04	28493	474									
03/10/04	45470	600									
03/17/04	51767	1431									
03/24/04	54445	1473									
03/31/04	58766	680	<MDA		1.66	<MDA		2.23	<MDA		2.04
04/07/04	59423	682									
04/14/04	64849	715									
04/21/04	70859	742									
04/28/04	75147	770	1.89	1.30	1.80	<MDA		3.09	<MDA		2.08
05/05/04	64996	718									
05/12/04	76565	777									
05/19/04	64104	712									
05/26/04	79723	789	<MDA		1.66	<MDA		3.06	<MDA		1.38
06/02/04	85254	817									
06/09/04	86213	846									
06/16/04	79139	786									
06/23/04	73360	758									
06/30/04	69410	738	<MDA		1.72	<MDA		2.53	<MDA		3.93
07/07/04	58545	837									
07/14/04	75421*	765									
07/21/04	74793	760									
07/28/04	76875	769	<MDA		2.57	<MDA		2.93	<MDA		1.95
08/04/04	81786	798									
08/11/04	77935	778									
08/18/04	73162	757									
08/25/04	71680	751									
09/01/04	71812	750	<MDA		2.89	<MDA		2.63	<MDA		3.48
09/08/04	66536	724									
09/15/04	46621	611									
09/22/04	62143	701									
09/29/04	59696	686	<MDA		2.43	<MDA		2.38	<MDA		3.54
10/06/04	54643	659									
10/13/04	62696	701									
10/20/04	61763	698									
10/27/04	62842	705	<MDA		2.46	<MDA		3.01	<MDA		3.41
11/03/04	63934	709									
11/12/04	64999	716									
11/17/04	63089	705									
11/24/04	77688	780	<MDA		1.89	<MDA		2.98	<MDA		3.58
12/01/04	49479	627									
12/08/04	65978	720									
12/15/04	57168	669									
12/22/04	66580	723									
12/29/04	56667	670									
N =	51		1			0			0		
Max. =	86213		1.89			ND			ND		
Min. =	28493		1.89			ND			ND		
Mean =	64085		1.89			ND			ND		
Median =	64849		1.89			ND			ND		
Std. Dev.=	12577.70		N/A			ND			ND		

*Results could not be verified or validated.
NR = Not Reported.
ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Steel Creek @ SC 125 (SV-327)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	2.20	1.10	1.03	<MDA		2.64	<MDA		4.00
01/07/04	2857	308									
01/14/04	2608	219									
01/21/04	2746	221									
01/28/04	2544	214	<MDA		2.4	<MDA		2.49	<MDA		2.12
02/04/04	2281	218									
02/11/04	2334	277									
02/18/04	2817	306									
02/25/04	3930	356	<MDA		2.05	<MDA		2.74	<MDA		1.95
03/03/04	5401	218									
03/10/04	5202	215									
03/17/04	2834	305									
03/24/04	3028	312									
03/31/04	3019	172	<MDA		1.79	<MDA		2.25	<MDA		1.94
04/07/04	3035	174									
04/14/04	3045	174									
04/21/04	3453	180									
04/28/04	3339	181	<MDA		1.76	<MDA		3.08	<MDA		1.97
05/05/04	3385	182									
05/12/04	3684	188									
05/19/04	3654	187									
05/26/04	4345	203	<MDA		1.89	<MDA		3.10	<MDA		3.72
06/02/04	4604	210									
06/09/04	4749	208									
06/16/04	3431	183									
06/23/04	3769	187									
06/30/04	3574	185	<MDA		1.87	<MDA		2.57	<MDA		3.98
07/07/04	3370	212									
07/14/04	4429*	201									
07/21/04	4325	200									
07/28/04	4630	203	<MDA		2.71	<MDA		2.94	<MDA		1.80
08/04/04	4359	200									
08/11/04	4988	212									
08/18/04	4030	193									
08/25/04	3866	191									
09/01/04	3485	185	3.71	1.93	2.84	<MDA		2.68	<MDA		3.45
09/08/04	2967	173									
09/15/04	2634	165									
09/22/04	3089	176									
09/29/04	3363	181	<MDA		2.41	<MDA		2.38	<MDA		3.44
10/06/04	3520	185									
10/13/04	3618	185									
10/20/04	3371	183									
10/27/04	3472	184	2.45	1.56	2.36	<MDA		3.00	<MDA		3.41
11/03/04	3225	178									
11/12/04	3281	180									
11/17/04	3285	180									
11/24/04	3333	179	2.05	1.38	1.95	<MDA		2.98	<MDA		3.27
12/01/04	2897	170									
12/08/04	3260	180									
12/15/04	3244	178									
12/22/04	3438	182									
12/29/04	2935	172									
N =	51		4			0			0		
Max. =	5401		3.71			ND			ND		
Min. =	2281		2.05			ND			ND		
Mean =	3483		2.6			ND			ND		
Median =	3370		2.33			ND			ND		
Std. Dev.=	711.10		0.76			ND			ND		

*Results could not be verified or validated.
NR = Not Reported.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Steel Creek Landing @ RM 141 (SV-2018)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	1.25	0.90	1.03	<MDA		2.64	<MDA		4.00
01/07/04	1137	217									
01/14/04	1585	182									
01/21/04	1185	162									
01/28/04	2939	227	<MDA		2.43	<MDA		2.5	<MDA		1.90
02/04/04	4540	295									
02/11/04	3033	311									
02/18/04	2836	308									
02/25/04	282	155	<MDA		1.96	<MDA		2.73	<MDA		2.06
03/03/04	2237	152									
03/10/04	867	114									
03/17/04	<192										
03/24/04	1064	205									
03/31/04	1196	124	<MDA		1.84	2.80	1.34	2.26	<MDA		2.04
04/07/04	1909	147									
04/14/04	506	103									
04/21/04	1230	124									
04/28/04	1115	123	<MDA		1.74	<MDA		3.08	<MDA		1.90
05/05/04	739	111									
05/12/04	707	111									
05/19/04	772	112									
05/26/04	655	110	<MDA		1.72	<MDA		3.07	<MDA		3.35
06/02/04	330	95									
06/09/04	821	117									
06/16/04	652	108									
06/23/04	1176	122									
06/30/04	1607	137	<MDA		1.87	<MDA		2.57	<MDA		3.51
07/07/04	601	122									
07/14/04	846*	113									
07/21/04	666	107									
07/28/04	534	98	<MDA		2.70	<MDA		2.94	<MDA		1.98
08/04/04	1167	123									
08/11/04	678	108									
08/18/04	482	99									
08/25/04	630	107									
09/01/04	<199		<MDA		2.58	<MDA		2.67	<MDA		3.34
09/08/04	373	98									
09/15/04	<190										
09/22/04	999	123									
09/29/04	684	110	<MDA		2.32	<MDA		2.37	<MDA		3.70
10/06/04	11541	319									
10/13/04	1587	139									
10/20/04	296	98									
10/27/04	833	115	<MDA		2.45	<MDA		3.01	<MDA		3.46
11/03/04	1083	123									
11/12/04	536	105									
11/17/04	<197										
11/24/04	452	99	<MDA		1.87	<MDA		2.98	<MDA		3.33
12/01/04	422	98									
12/08/04	1136	126									
12/15/04	<195										
12/22/04	2380	158									
12/29/04	1175	127									
N =	46		1			1			0		
Max. =	11541		1.25			2.8			ND		
Min. =	ND		1.25			2.8			ND		
Mean =	1378		1.25			2.8			ND		
Median =	933		1.25			2.8			ND		
Std. Dev.=	1754.39		N/A			N/A			ND		

*Results could not be verified or validated.
NR = Not Reported.
ND = None detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Little Hell Boat Landing (SV-2019)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/07/04	468	174
01/14/04	663	143
01/21/04	609	136
01/28/04	456	127
02/04/04	862	156
02/11/04	864	190
02/18/04	373	162
02/25/04	284	156
03/03/04	943	115
03/10/04	649	106
03/17/04	269	153
03/24/04	900	194
03/31/04	360	94
04/07/04	2238	155
04/14/04	990	119
04/21/04	749	108
04/28/04	605	106
05/05/04	595	106
05/12/04	567	106
05/19/04	582	105
05/26/04	332	99
06/02/04	386	98
06/09/04	1508	148
06/16/04	338	97
06/23/04	453	96
06/30/04	552	103
07/07/04	352	112
07/14/04	287*	92
07/21/04	442	99
07/28/04	404	93
08/04/04	520	101
08/11/04	721	109
08/18/04	411	97
08/25/04	415	99
09/01/04	395	100
09/08/04	270	93
09/15/04	<190	
09/22/04	217	93
09/29/04	348	98
10/06/04	5269	224
10/13/04	241	93
10/20/04	341	100
10/27/04	235	92
11/03/04	540	104
11/12/04	464	102
11/17/04	215	92
11/24/04	345	95
12/01/04	737	109
12/08/04	370	99
12/15/04	<195	
12/22/04	297	93
12/29/04	654	109
N =	49	
Max. =	5269	
Min. =	ND	
Mean =	649	
Median =	456	
Std. Dev.=	758.19	

*Results could not be verified or validated.

Sample Location: Upper Three Runs @ Road 2-1 (SV-2027)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/07/04	<200	
01/14/04	245	121
01/21/04	241	116
01/28/04	390	124
02/04/04	271	121
02/11/04	278	146
02/18/04	207	149
02/25/04	256	153
03/03/04	347	93
03/10/04	194	88
03/17/04	<192	
03/24/04	261	147
03/31/04	322	93
04/07/04	<195	
04/14/04	<195	
04/21/04	382	94
04/28/04	253	92
05/05/04	220	91
05/12/04	211	92
05/19/04	228	90
05/26/04	<201	
06/02/04	207	90
06/09/04	395	101
06/16/04	<195	
06/23/04	326	91
06/30/04	223	90
07/07/04	<195	
07/14/04	254*	91
07/21/04	207	89
07/28/04	218	85
08/04/04	300	92
08/11/04	352	95
08/18/04	345	94
08/25/04	207	90
09/01/04	<199	
09/08/04	460	106
09/15/04	343	95
09/22/04	<199	
09/29/04	259	94
10/06/04	250	94
10/13/04	245	93
10/20/04	323	99
10/27/04	241	93
11/03/04	292	94
11/12/04	335	97
11/17/04	313	96
11/24/04	417	101
12/01/04	263	91
12/08/04	<199	
12/15/04	<195	
12/22/04	267	92
12/29/04	<197	
N=	39	
Max.=	460	
Min.=	ND	
Mean =	284	
Median =	263	
Std. Dev.=	172.66	

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: US-301 Bridge (SV-118)												
Date	Tritium		Gross Alpha			Gross Beta			Cs-137			
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	1.49	0.986	1.09	<MDA		2.66	<MDA		4.00
01/07/04	593	182									
01/14/04	536	136									
01/21/04	672	139									
01/28/04	1054	156	<MDA		2.53	<MDA		2.51	<MDA		1.86
02/04/04	1300	176									
02/11/04	1266	216									
02/18/04	1100	212									
02/25/04	738	188	<MDA		1.96	<MDA		2.73	<MDA		1.83
03/03/04	759	108									
03/10/04	670	107									
03/17/04	522	172									
03/24/04	816	188									
03/31/04	874	113	2.26	1.58	2.14	4.73	1.48	2.3	<MDA		1.83
04/07/04	1600	138									
04/14/04	1825	144									
04/21/04	1377	128									
04/28/04	643	108	<MDA		2.16	<MDA		3.14	<MDA		1.80
05/05/04	1026	121									
05/12/04	563	106									
05/19/04	399	97									
05/26/04	431	102	<MDA		1.72	<MDA		3.07	<MDA		3.35
06/02/04	395	98									
06/09/04	681	111									
06/16/04	369	98									
06/23/04	504	98									
06/30/04	371	96	<MDA		1.89	<MDA		2.57	<MDA		3.98
07/07/04	388	112									
07/14/04	357*	95									
07/21/04	432	98									
07/28/04	545	98	<MDA		2.80	<MDA		2.95	<MDA		1.84
08/04/04	433	97									
08/11/04	504	101									
08/18/04	540	101									
08/25/04	778	112									
09/01/04	332	98	<MDA		2.81	<MDA		2.62	<MDA		3.23
09/08/04	286	94									
09/15/04	203	89									
09/22/04	375	100									
09/29/04	408	100	<MDA		2.32	2.66	1.39	2.37	<MDA		3.32
10/06/04	276	95									
10/13/04	245	93									
10/20/04	226	95									
10/27/04	427	100	<MDA		2.50	<MDA		3.01	<MDA		3.38
11/03/04	615	107									
11/12/04	529	104									
11/17/04	473	102									
11/24/04	282	92	<MDA		1.92	<MDA		2.98	<MDA		3.36
12/01/04	734	109									
12/08/04	447	102									
12/15/04	256	93									
12/22/04	257	92									
12/29/04	619	108									
N =	51		2			2			0		
Max. =	1825		2.26			4.73			ND		
Min. =	203		1.49			2.66			ND		
Mean =	621		1.87			3.69			ND		
Median =	529		1.87			3.69			ND		
Std. Dev.=	358.87		0.54			1.46			ND		

*Results could not be verified or validated.
NR = Not Reported.
ND = None Detected.

Radiological Surface Water Monitoring
Radiological Surface Water Data

Sample Location: Lower Three Runs @ Road B (SV-2053)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA	pCi/L	+/-2 Sigma	MDA
12/31/03	NR	NR	<MDA		0.922	2.81	1.47	2.61	<MDA		3.98
01/07/04	454	172									
01/14/04	532	136									
01/21/04	744	142									
01/28/04	571	133	<MDA		2.25	<MDA		2.47	<MDA		2.25
02/04/04	492	134									
02/11/04	539	166									
02/18/04	381	162									
02/25/04	473	169	2.27	1.36	1.85	<MDA		2.71	<MDA		2.32
03/03/04	504	98									
03/10/04	458	99									
03/17/04	612	178									
03/24/04	583	172									
03/31/04	732	108	<MDA		1.56	2.65	1.29	2.21	<MDA		2.25
04/07/04	505	103									
04/14/04	462	101									
04/21/04	579	101									
04/28/04	497	102	<MDA		1.54	<MDA		3.04	<MDA		2.48
05/05/04	524	103									
05/12/04	326	96									
05/19/04	711	109									
05/26/04	636	109	<MDA		1.64	3.07	1.71	3.06	<MDA		3.79
06/02/04	849	114									
06/09/04	1253	130									
06/16/04	552	105									
06/23/04	510	98									
06/30/04	537	103	<MDA		1.72	<MDA		2.53	<MDA		3.99
07/07/04	517	118									
07/14/04	663*	106									
07/21/04	1011	118									
07/28/04	763	107	<MDA		2.54	<MDA		2.92	<MDA		2.08
08/04/04	658	107									
08/11/04	647	107									
08/18/04	604	104									
08/25/04	823	113									
09/01/04	683	112	<MDA		2.51	4.19	1.57	2.61	<MDA		3.55
09/08/04	552	105									
09/15/04	475	100									
09/22/04	413	101									
09/29/04	422	100	<MDA		2.10	<MDA		2.36	<MDA		3.37
10/06/04	439	102									
10/13/04	526	104									
10/20/04	501	105									
10/27/04	539	104	<MDA		2.15	<MDA		2.99	<MDA		3.45
11/03/04	494	102									
11/12/04	435	100									
11/17/04	610	107									
11/24/04	555	103	<MDA		1.77	<MDA		2.97	<MDA		3.68
12/01/04	439	98									
12/08/04	443	102									
12/15/04	399	99									
12/22/04	424	98									
12/29/04	404	100									
N =	51		1			4			0		
Max. =	1253		2.27			4.19			ND		
Min. =	326		ND			2.65			ND		
Mean =	565		1.59			3.18			ND		
Median =	526		1.59			2.94			ND		
Std. Dev.=	163.80		N/A			0.70			ND		

*Results could not be verified or validated.
NR = Not Reported.
ND = None Detected.

Radiological Surface Water Monitoring
Boat Run Data

Sample Location: Upper Three Runs Mouth @ RM 157.4 (SV-2011)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/12/04	1670	140
02/09/04	1199	125
03/15/04	16159	362
04/19/04	1313	130
05/17/04	217	121
06/14/04	2834	168
07/12/04	737	109
08/09/04*	772	111
09/13/04**	425	100
10/11/04	NS	NS
11/08/04	650	108
12/10/04	1598	200
N =	11	
Max. =	16159	
Min. =	217	
Mean =	2507	
Median =	1199	
Std. Dev. =	4586.04	

Sample Location: Beaver Dam Creek Mouth @ RM 152.3 (SV-2013)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/12/04	566	105
02/09/04	566	103
03/15/04	1891	144
04/19/04	379	98
05/17/04	2863	244
06/14/04	475	137
07/12/04	440	135
08/09/04*	430	136
09/13/04**	<192	
10/11/04	NS	NS
11/08/04	289	131
12/10/04	273	130
N =	11	
Max. =	2863	
Min. =	273	
Mean =	817	
Median =	458	
Std. Dev. =	859.01	

NS = No sample collected.
*Result could not be verified or validated.
**River level increased.
NOTE: Samples not collected in October due to river flooding.

Radiological Surface Water Monitoring
Boat Run Data

Sample Location: Four Mile Creek @ RM 150.6 (SV-2015)						
Date	Tritium (at Creek Mouth (CM))		Tritium (30 Feet from CM)		Tritium (150 Feet from CM)	
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma
01/12/04	88718	830	<195		32748	508
02/09/04	79912	786	78738	779	21658	414
03/15/04	58057	673	41306	569	29215	480
04/19/04	73605	760	73083	757	56009	663
05/17/04	38617	899	24049	697	9116	420
06/14/04	38852	909	24260	706	8831	416
07/12/04	60468	1149	<187		2336	224
08/09/04*	60574	1157	<190		11015	467
09/13/04**	199	90	<192		<192	
10/11/04	NS	NS	NS	NS	NS	NS
11/08/04	72398	1274	198	125	2085	218
12/10/04	34760	860	11929	487	6543	362
N =	11		11		11	
Max. =	88718		78738		56009	
Min. =	199		198		<192	
Mean =	55105		36223		16324	
Median =	60468		24260		10066	
Std. Dev. =	25334.77		29920.28		17136.78	

NS = No samples collected.
*Result could not be verified or validated.
**River level increased.

Sample Location: Steel Creek Mouth @ RM 141.8 (SV-2017)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/12/04	12565	324
02/09/04	19683	398
03/15/04	9155	280
04/19/04	7918	263
05/17/04	4075	286
06/14/04	4281	295
07/12/04	3073	253
08/09/04*	5094	321
09/13/04**	<192	
10/11/04	NS	NS
11/08/04	3976	295
12/10/04	12478	513
N =	11	
Max. =	19683	
Min. =	ND	
Mean =	7483	
Median =	6506	
Std. Dev. =	5336.94	

NS = No samples collected.
ND = No detection
*Result could not be verified or validated.
**River level increased.

Sample Location: Lower Three Runs Mouth @ RM 129 (SV-2020)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/12/04	973	119
02/09/04	660	107
03/15/04	702	109
04/19/04	1042	122
05/17/04	901	161
06/14/04	1051	169
07/12/04	1448	187
08/09/04*	1815	205
09/13/04**	218	90
10/11/04	NS	NS
11/08/04	1197	180
12/10/04	496	144
N =	11	
Max. =	1815	
Min. =	218	
Mean =	955	
Median	973	
Std. Dev. =	443.41	

*Result could not be verified or validated.
**River levels increased.

Radiological Surface Water Monitoring
Radiological Sediment Monitoring

Date: 8/16/2004	Cs-137	Pu-238	Pu-239,240	Tc-99
SV-2010	<MDA	0.004 U	0.004 U	1.20 U
+/-2 Sigma		0.009	0.009	0.74
MDA	0.017	0.018	0.020	1.29
SV-2045	1.143	0.016 U	0.004 U	0.839 U
+/-2 Sigma	0.162	0.020	0.011	0.71
MDA	0.013	0.027	0.026	1.25
SV-325	0.106	<MDA	0.009 U	0.225 U
+/-2 Sigma	0.034		0.019	0.68
MDA	0.030	0.038	0.025	1.26
SV-2012	0.036	<MDA	0.002 U	0.837 U
+/-2 Sigma	0.018		0.009	0.71
MDA	0.018	0.032	0.027	1.27
SV-2040	<MDA	<MDA	<MDA	0.409 U
+/-2 Sigma				0.68
MDA	0.028	0.198	0.158	1.25
SV-2039	2.733	0.030 U	0.044 U	0.635 U
+/-2 Sigma	0.386	0.044	0.054	0.70
MDA	0.033	0.063	0.070	1.26
SV-2047	<MDA	<MDA	0.007 U	0.38 U
+/-2 Sigma			0.013	0.68
MDA	0.012	0.030	0.026	1.26
SV-327	0.376	<MDA	<MDA	1.21 U
+/-2 Sigma	0.057			0.74
MDA	0.012	0.023	0.018	1.28
SV-2018	0.421	<MDA	<MDA	1.20 U
+/-2 Sigma	0.071			0.74
MDA	0.026	0.116	0.049	1.30
SV-2019	0.035	<MDA	0.017 U	0.395 U
+/-2 Sigma	0.013		0.034	0.68
MDA	0.014	0.046	0.046	1.25
SV-118	0.145	0.009 U	<MDA	0.829 U
+/-2 Sigma	0.039	0.017		0.71
MDA	0.024	0.024	0.049	1.26
SV-2053	0.218	<MDA	0.015 U	0.280 U
+/-2 Sigma	0.043		0.031	0.68
MDA	0.026	0.074	0.041	1.26
SV-2027	0.147	<MDA	0.022 U	2.68 J
+/-2 Sigma	0.047		0.056	0.84
MDA	0.026	0.131	0.130	1.39

8/9/2004	Cs-137	Pu-238	Pu-239,240	Tc-99
SV-2011	<MDA	<MDA	<MDA	0.45 U
+/-2 Sigma				0.69
MDA	0.024	0.032	0.055	1.26
SV-2013	<MDA	<MDA	0.009 U	0.732 U
+/-2 Sigma			0.024	0.71
MDA	0.026	0.067	0.056	1.27
SV-2015	0.291	<MDA	<MDA	0.792 U
+/-2 Sigma	0.053			0.71
MDA	0.025	0.022	0.039	1.26
SV-2017	0.960	0.009 U	0.015 U	1.11 U
+/-2 Sigma	0.141	0.019	0.028	0.73
MDA	0.029	0.026	0.054	1.26
SV-2020	1.244	<MDA	<MDA	0.671 U
+/-2 Sigma	0.180			0.70
MDA	0.030	0.031	0.030	1.27

Notes:

U - analyzed for, but the result is less than the MDA.

J - No U I< qualifier has been assigned and the result is below the reporting limit or report value is estimated.

2.4 Non-Radiological Surface Water and Sediment Monitoring

2.4.1 Summary

The streams located on the Savannah River Site (SRS) receive treated wastewater and nonpoint source runoff from on-site facilities. Recent and historical data from SRS Environmental Reports indicate that the SRS waters are in accordance with Freshwaters Standard guidelines stated in the South Carolina Department of Health and Environmental Control (SCDHEC) Water Classifications and Standards (Regulation 61-68), 2004.

In 2004, the Environmental Surveillance Oversight Program (ESOP) assessed the nonradiological sediment and surface water quality on SRS by sampling the on-site streams for inorganic and organic contaminants. Specific parameters were analyzed monthly, quarterly, and annually. Sample sites were strategically chosen to monitor ambient sediment and surface water conditions to detect the nonradiological impact from the Department of Energy – Savannah River (DOE-SR) operations (Map 6, section 2.4.2).

RESULTS AND DISCUSSION

Sediments

Sediment samples were not taken in 2004 due to financial constrictions. Sampling of sediments will resume in 2005.

Surface Water

ESOP field personnel recorded pH at each sample location during each sampling event. The freshwaters pH standard for South Carolina is between 6.0 and 8.5 (SCDHEC 1998). Measurements below the standard range for pH were repeatedly observed in 2004 at Upper Three Runs (SV-2027), which is the background location not typically affected by SRS operations. These measurements ranged from 4.09 to 5.45. The pH did reach the standard range in April, when it was observed at 6.01. Low pH is typical for black water streams such as Upper Three Runs (USGS 2000). All surface water data can be found in section 2.4.4. The pH was low in the last few months of the year in several other locations as well. At Tims Branch (SV-324) the pH ranged from 4.74 to 4.96 from September through December. At Four Mile Creek (SV-326) the pH ranged from 5.18 to 5.90 from September through December. The pH was also low at the other Upper Three Runs location (SV-325) where it ranged from 5.11 to 5.37 from September through December.

Nitrate/nitrite concentrations above the state average of 0.639 mg/L were observed from monthly samples collected at Four Mile Creek (SV-326) location (Figure 1, section 2.4.3). The average nitrate concentration at the Four Mile Creek location (SV-326) was 1.29 mg/L, which increased from the 2003 average of 0.75 mg/L (SCDHEC 2004). The elevated nitrate level may be explained by groundwater beneath F-Area and H-Area seepage basins outcropping into Four Mile Creek (RAC 1999). However, the observed levels of nitrate are still below the 10 mg/L Maximum Contaminant Level (MCL) (U.S. EPA 1996). If nitrate levels continue to increase, additional sampling may be required.

The DOE-SR surface water sample location FM-6 on Four Mile Creek is located approximately four miles downstream from the ESOP surface water sample location (SV-326). The DOE-SR average concentration for this location in 2004 was 0.785 mg/L. As shown in Figure 1, DOE-SR nitrate levels for Four Mile Creek have been consistently below ESOP nitrate levels.

ESOP field personnel collected surface water samples for fecal coliform analysis at each location during each sampling event. The freshwaters fecal coliform standard for South Carolina is: five consecutive samples during any 30 day period shall not exceed a geometric mean of 200 colonies/100 mL membrane fecal coliform (MFC); nor shall more than 10 percent of the total samples during any 30 day period exceed 400 colonies/100mL MFC (SCDHEC 2004). Of the 101 fecal coliform samples taken in 2004, only one, a blind duplicate, was greater than 400 colonies/100mL MFC.

Samples analyzed for other parameters (including but not limited to conductivity, alkalinity, metals, total organic carbon, volatile organic compounds, pesticides and polychlorinated biphenyl) indicated no deviations from established freshwater conditions during this study (SCDHEC 2004). All surface water data are located in section 2.4.4. Surface water statistical analysis can be found in section 2.4.5.

ESOP and DOE-SR (WSRC 2005) data comparison for the four colocated sample locations for 2004 are found in section 2.4.4. The data comparison includes yearly averages, yearly observed maximums, yearly minimums, and yearly standard deviations. At DOE-SR site U3R-1A, which is located on the Upper Three Runs, pH, water temperature, total suspended solids, total phosphorus, and nitrate/nitrite levels were all within one standard deviation of ESOP site SV-2027. Dissolved oxygen and iron were within two standard deviations. At ESOP site SV-2027, zinc was within three and total organic carbon was within four standard deviations of DOE-SR site U3R-1A. At DOE-SR site TB-5, which is located on Tims Branch, pH, water temperature, total suspended solids, nitrate/nitrite levels, and total organic carbon, were within one standard deviation of ESOP site SV-324. Dissolved oxygen, iron, and manganese were within two standard deviations. At DOE-SR site U3R-4, which is located on Upper Three Runs, dissolved oxygen, water temperature, total phosphorus, nitrate/nitrite levels, iron, manganese, zinc, and total organic carbon were within one standard deviation of ESOP site SV-325. Total suspended solids and pH were within two standard deviations. At DOE-SR site SC-4, which is located on Steel Creek, water temperature, total suspended solids, nitrate/nitrite levels, total phosphorus, iron, manganese, and total organic carbon, were within one standard deviation of ESOP site SV-327. Dissolved oxygen, pH, and zinc were within two standard deviations.

Note that South Carolina state averages are from the Summary of Selected Water Quality Parameter Concentrations in South Carolina Water and Sediments (SCDHEC 1998)

CONCLUSIONS AND RECOMMENDATIONS

All observed parameters that DOE-SR and ESOP had in common were within three standard deviations except total organic carbon. This may be due to different sampling times, which could have been effected by weather differences. A comparison of DOE-SR and ESOP sediment data could not be completed because sediment samples were not taken in 2004.

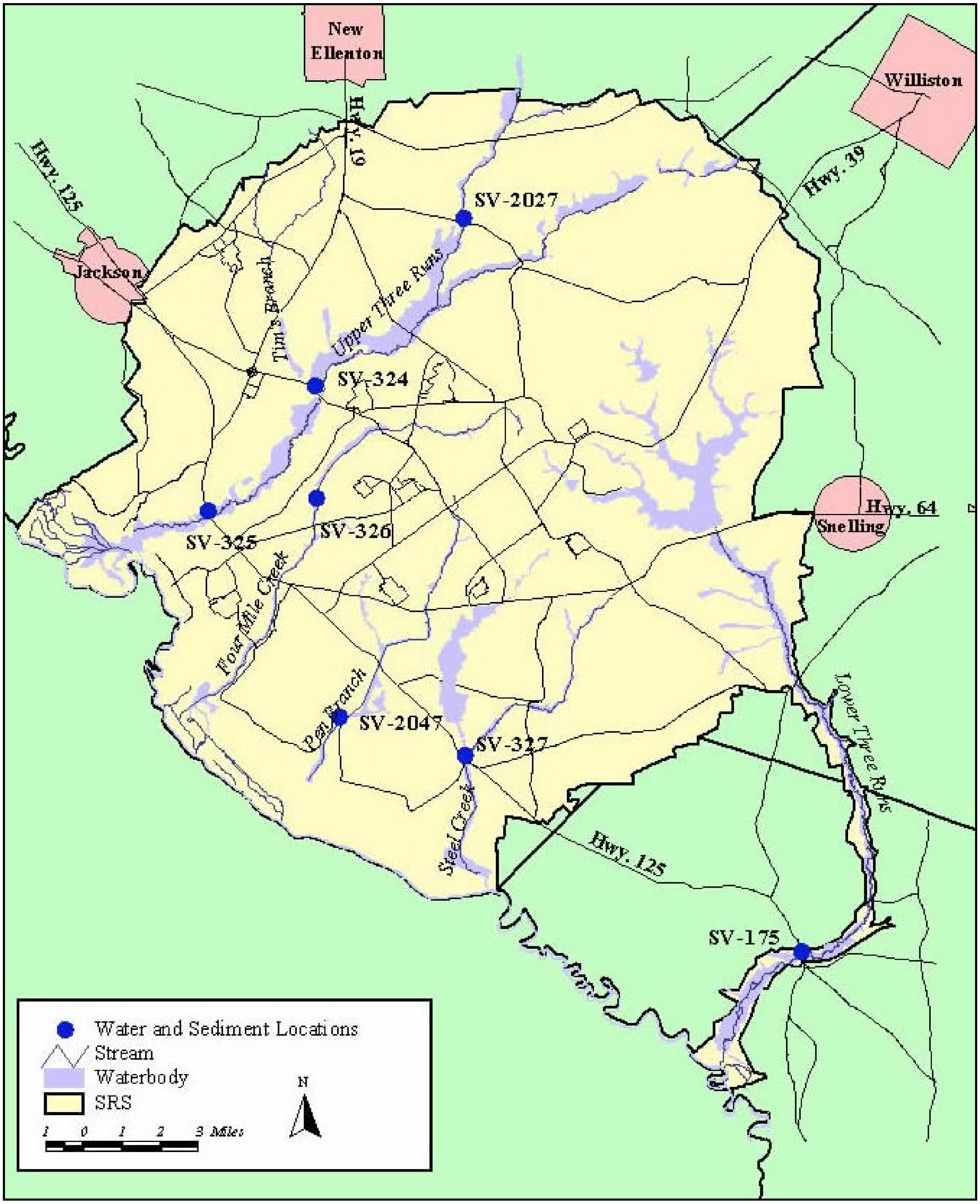
Measurements of pH, ranging from 4.09 to 6.01, were observed at the Upper Three Runs (SV-2027) sample location, a background location not typically affected by SRS operations.

DOE-SR reported that the pH indicated normal trends for a southern pine forest stream (WSRC 2002). Also, nitrate concentrations from Four Mile Creek (SV-326) were higher than the average nitrate levels measured at the other seven locations. The higher nitrate levels observed at Four Mile Creek (SV-326) are a possible result of discharge from the waste treatment facility (WSRC 2001). This facility is upstream from the sample site. Additional sampling may need to be conducted above the treatment plant in order to verify this. The maximum nitrate concentration observed at SV-326 during 2004 was 2.1 mg/L with a mean concentration of 1.29 mg/L for all 2004 samples collected at this sample site. All sample results were below the United States Environmental Protection Agency National Primary Drinking Water Standard MCL of 10 mg/L for nitrate/nitrite concentrations (U.S. EPA 1996). Overall, the nonradiological water quality on the SRS compares favorably with the South Carolina Freshwaters standard for the parameters and locations monitored in this study.

South Carolina state averages are from the Summary of Selected Water Quality Parameter Concentrations in South Carolina Water and Sediments (SCDHEC 1998). The state averages will continue to be used as comparison data.

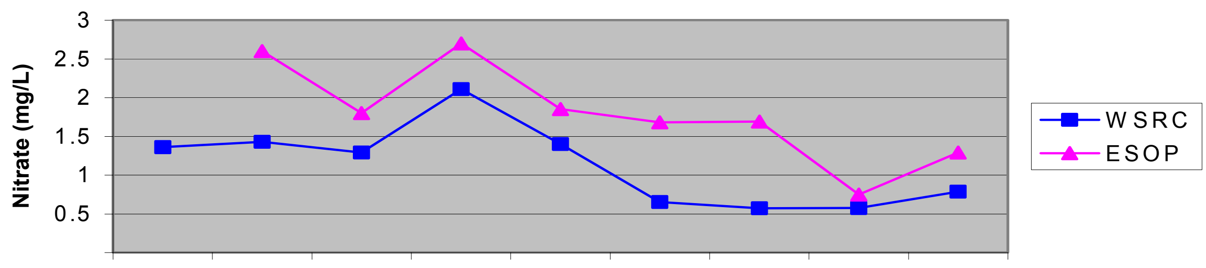
ESOP will continue the nonradiological independent monitoring and surveillance of SRS surface water to verify and validate water quality. Continued monitoring is required because of increased land disturbance from accelerated clean-up, logging, and the potential for new emissions. The future locations, numbers of samples, sample frequencies and monitoring parameters may change to maximize available resources and address critical issues.

2.4.2
Map 6. Non-radiological Surface Water and Sediment Sampling Locations



2.4.3 Tables and Figures
Non-radiological Surface Water and Sediment Sampling

Figure 1
DOE-SR and ESOP Nitrate Levels in Four Mile Creek



2.4.4 Data
Non-radiological Surface Water and Sediment Monitoring Data

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-2027							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	5.45	5.41	NS	6.10	5.01	AP
	DO	mg/L	9.57	AP	NS	9.01	7.58	7.82
	Water Temperature	celsius	10	11.0	NS	17.4	20.4	21.9
	Conductivity	mS/cm	0.032	1.165	NS	0.029	0.073	0.066
	Alkalinity	mg/L	<1.0	<1.0	NS	<1.0	<1.0	<1.0
	Turbidity	NTU	1.2	1.2	NS	1.4	1.8	1.7
	BOD	mg/L	AP	3.4	NS	2.1	5.1	AP
	TSS	mg/L	2.7	2.7	NS	1.7	6.0	1.2
	Fecal Coliform (MFC)	FC/100mL	140	100	NS	100	78	78
	NH3 NH4	mg/L	<0.050	<0.050	NS	<0.050	0.11	0.14
	NO3 NO2	mg/L	0.28	.26	NS	0.22	0.24	0.22
	TKN	mg/L	<0.10	.29	NS	0.25	0.48	0.42
	Total Phosphorus	mg/L	<0.020	<0.020	NS	<0.020	<0.020	0.024
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	.18	NS	NS	.23	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	0.015	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	<2.0	NS	NS	<2.0	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	5.30	5.19	4.09	5.04	4.51	4.24
	DO	mg/L	7.39	AP	8.23	8.39	9.00	10.16
	Water Temperature	celsius	23.4	22.0	20.5	18.6	19.7	12.7
	Conductivity	mS/cm	0.044	AP	AP	AP	AP	0.071
	Alkalinity	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Turbidity	NTU	1.9	3.4	1.9	1.2	1.1	<1.0
	BOD	mg/L	<2.0	4.1	>7.4	<2.0	<2.0	2.2
	TSS	mg/L	2.5	8.3	1.2	0.70	0.8	1.3
	Fecal Coliform (MFC)	FC/100mL	70	300	90	180	190	110
	NH3 NH4	mg/L	0.19	<0.050	<0.050	0.05	<0.050	<0.050
	NO3 NO2	mg/L	0.21	0.170	0.20	0.20	0.19	0.250
	TKN	mg/L	0.94	0.33	<0.10	0.15	<0.10	0.13
	Total Phosphorus	mg/L	0.05	<0.020	<0.020	<0.020	<0.020	0.028
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.33	NS	NS	0.20	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	4	NS	NS	<2.0	NS	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-324							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	6.01	6.01	NS	6.80	6.55	AP
	DO	mg/L	9.62	AP	NS	8.17	9.40	7.64
	Water Temperature	celsius	6.9	8.9	NS	17.7	21.0	23.6
	Conductivity	mS/cm	0.025	0.068	NS	0.040	0.026	0.037
	Alkalinity	mg/L	4.2	4.4	NS	4.8	5.1	8.0
	Turbidity	NTU	2.6	2.9	NS	3.9	5.2	5.8
	BOD	mg/L	AP	3.5	NS	<2.0	<2.0	AP
	TSS	mg/L	2.6	3.2	NS	3.4	7.1	AP
	Fecal Coliform (MFC)	FC/100mL	28	8	NS	70	130	240
	NH3 NH4	mg/L	<0.050	<0.050	NS	0.052	0.11	0.14
	NO3 NO2	mg/L	0.16	.12	NS	0.10	0.073	0.045
	TKN	mg/L	0.26	.30	NS	0.32	0.36	0.28
	Total Phosphorus	mg/L	<0.020	<0.020	NS	0.033	0.053	0.077
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	.97	NS	NS	1.5	NS	NS
	Lead	mg/L	<0.010	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.036	NS	NS	0.056	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	2.5	NS	NS	4.8	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	6.01	5.93	4.96	4.96	4.91	4.74
	DO	mg/L	8.51	8.59	8.59	8.51	7.71	10.01
	Water Temperature	celsius	24.2	21.3	18.8	18.8	20.2	10.1
	Conductivity	mS/cm	0.047	AP	AP	AP	AP	0.047
	Alkalinity	mg/L	9.1	6.4	6.5	5.0	6.3	4
	Turbidity	NTU	7.9	4.4	3.8	3.8	3.8	2.4
	BOD	mg/L	<2.0	<2	<2.	<2.0	<2.0	<2.0
	TSS	mg/L	4.6	5.8	4.0	4.00	5.2	3.0
	Fecal Coliform (MFC)	FC/100mL	55	350	140	140	150	35
	NH3 NH4	mg/L	0.21	<0.050	<0.050	0.072	<0.050	0.05
	NO3 NO2	mg/L	0.02	0.02	0.037	0.035	0.033	0.092
	TKN	mg/L	0.51	0.32	0.27	0.26	0.1	0.15
	Total Phosphorus	mg/L	0.050	0.044	0.052	0.037	0.046	0.037
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	2.2	NS	NS	1.3	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.13	NS	NS	0.052	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	5.2	NS	NS	3.0	NS	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location: SV-326								
Sample Date:		**units**	**Jan-04**	**Feb-04**	**Mar-04**	**Apr-04**	**May-04**	**Jun-04**
Monthly Parameters	pH	su	6.0	5.74	NS	7.04	6.64	AP
	DO	mg/L	9.76	AP	NS	7.73	8.14	7.13
	Water Temperature	celsius	6.0	9.5	NS	19.5	22.3	24.8
	Conductivity	mS/cm	0.064	0.136	NS	0.064	0.056	0.068
	Alkalinity	mg/L	13	7.7	NS	17	16	17
	Turbidity	NTU	6.0	4.2	NS	4.7	5.1	6.4
	BOD	mg/L	AP	4.9	NS	<2.0	<2.0	AP
	TSS	mg/L	6.3	2.8	NS	1.8	1.0	1.6
	Fecal Coliform (MFC)	FC/100mL	260	48	NS	62	45	75
	NH3 NH4	mg/L	<0.050	<0.050	NS	0.12	0.12	0.16
	NO3 NO2	mg/L	2.1	0.91	NS	1.5	1.1	1.1
	TKN	mg/L	0.35	0.31	NS	0.41	0.45	0.66
	Total Phosphorus	mg/L	0.15	0.043	NS	0.21	0.18	0.17
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.80	NS	NS	1.1	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.11	NS	NS	0.11	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	0.035	NS	NS	0.018	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	2.7	NS	NS	5.7	NS	NS
Sample Date:		**units**	**Jul-04**	**Aug-04**	**Sep-04**	**Oct-04**	**Nov-04**	**Dec-04**
Monthly Parameters	pH	su	6.40	6.18	5.90	5.90	5.39	5.18
	DO	mg/L	8.58	AP	8.72	7.86	9.14	9.63
	Water Temperature	celsius	26.7	24.0	22.3	19.5	21.2	10.2
	Conductivity	mS/cm	0.090	AP	AP	AP	AP	0.074
	Alkalinity	mg/L	28	21	15	18	22	12
	Turbidity	NTU	9.8	2.9	3.1	3.0	4.0	3.5
	BOD	mg/L	<2.0	<2.0	<2	2.3	<2.0	<2.0
	TSS	mg/L	1.2	1.8	1.8	0.80	1.6	2.0
	Fecal Coliform (MFC)	FC/100mL	48	290	180	120	310	290
	NH3 NH4	mg/L	0.16	<0.050	<0.050	0.08	0.06	0.08
	NO3 NO2	mg/L	1.00	1.30	1.00	1.70	1.50	0.980
	TKN	mg/L	0.38	0.44	0.27	0.30	0.19	0.22
	Total Phosphorus	mg/L	0.21	0.220	0.04	0.17	0.19	0.110
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	1.7	NS	NS	0.89	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.07	NS	NS	0.023	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	5.9	NS	NS	4.3	NS	NS

* No Volatile Organic Compounds,
Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-325							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	AP	6.04	6.01	6.01	6.38	AP
	DO	mg/L	AP	AP	AP	7.91	8.89	7.47
	Water Temperature	celsius	AP	9.9	16.4	16.0	20.9	23.0
	Conductivity	mS/cm	AP	0.014	0.037	0.021	0.021	0.025
	Alkalinity	mg/L	3.3	2.1	3.5	3.2	3.2	2.8
	Turbidity	NTU	2.0	2.1	2.8	4.4	2.8	3.2
	BOD	mg/L	<2.0	<2.0	6.9	2.4	<2.0	AP
	TSS	mg/L	5.2	2.1	5.1	3.0	1.3	9.2
	Fecal Coliform (MFC)	FC/100mL	34(e)	6	82	100	200	130
	NH3 NH4	mg/L	<0.050	<0.050	0.071	0.11	0.15	0.12
	NO3 NO2	mg/L	0.14	0.14	0.10	0.16	0.17	0.13
	TKN	mg/L	0.30	0.34	0.28	0.43	0.38	0.41
	Total Phosphorus	mg/L	<0.020	<0.020	0.024	0.057	0.049	0.054
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	.64	NS	NS	0.46	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.032	NS	NS	0.029	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	0.012	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	2.3	NS	NS	3.0	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	5.52	6.40	5.14	5.11	5.37	5.31
	DO	mg/L	8.47	AP	0.47	9.41	8.05	10.02
	Water Temperature	celsius	23.4	22.8	21.4	17.9	20	11.3
	Conductivity	mS/cm	AP	AP	AP	AP	AP	0.044
	Alkalinity	mg/L	3.0	3.2	1.9	3.6	3.7	2
	Turbidity	NTU	2.1	4.8	2.9	1.6	1.6	1.9
	BOD	mg/L	7.1	<2.0	4.0	6.6	<2.0	<2.0
	TSS	mg/L	2.5	4.0	2.8	0.7	1.1	1.2
	Fecal Coliform (MFC)	FC/100mL	100	280	220	180	220	120
	NH3 NH4	mg/L	0.079	<0.050	0.065	0.06	<0.050	0.06
	NO3 NO2	mg/L	0.11	0.18	0.11	0.13	0.09	0.110
	TKN	mg/L	0.24	0.30	0.33	0.20	<0.10	0.23
	Total Phosphorus	mg/L	0.038	0.050	0.120	0.02	0.03	0.024
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.26	NS	NS	0.32	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.028	NS	NS	<0.010	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	6.3	NS	NS	2.0	NS	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-2047							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	7.29	5.89	NS	6.13	6.81	AP
	DO	mg/L	NS	AP	NS	8.59	9.08	8.94
	Water Temperature	celsius	12.6	9.5	NS	14.6	23.1	26.0
	Conductivity	mS/cm	0.056	0.045	NS	0.055	0.060	0.122
	Alkalinity	mg/L	15	13	NS	20	22	22
	Turbidity	NTU	3.4	3.3	NS	3.1	3.9	5.2
	BOD	mg/L	<2.0	<2.0	NS	2.1	<2.0	AP
	TSS	mg/L	8.8	3.6	NS	4.0	0.80	1.9
	Fecal Coliform (MFC)	FC/100mL	38(e)	40	NS	120	30	100
	NH3 NH4	mg/L	0.056	<0.050	NS	0.12	0.15	0.069
	NO3 NO2	mg/L	0.10	0.17	NS	0.18	0.21	0.15
	TKN	mg/L	0.28	0.37	NS	0.36	0.36	0.63
	Total Phosphorus	mg/L	<0.020	<0.020	NS	0.036	0.038	0.039
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	.51	NS	NS	0.84	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.042	NS	NS	0.064	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	3.9	NS	NS	4.6	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	6.48	6.01	6.04	6.00	5.66	5.53
	DO	mg/L	7.41	AP	7.01	8.89	8.21	10.01
	Water Temperature	celsius	26.2	25.1	22.5	19.2	21.8	11.1
	Conductivity	mS/cm	0.113	AP	AP	AP	AP	0.005
	Alkalinity	mg/L	22	22	21	0	23	18
	Turbidity	NTU	2.5	2.2	2.9	2.2	2.3	2.3
	BOD	mg/L	>7.5	>7.5	<2	<2.0	3	<2.0
	TSS	mg/L	1.7	1.1	1.0	0.5	2	1.2
	Fecal Coliform (MFC)	FC/100mL	50	60	150	90	100	80
	NH3 NH4	mg/L	0.083	<0.050	<0.050	<0.050	<0.050	0.07
	NO3 NO2	mg/L	0.100	0.11	0.150	0.14	0.120	0.150
	TKN	mg/L	0.29	0.37	0.84	0.23	0.19	0.24
	Total Phosphorus	mg/L	0.034	0.03	0.027	0.023	0.028	0.071
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.5	NS	NS	0.47	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.042	NS	NS	0.018	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	3.4	NS	NS	4.1	NS	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-327							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	6.97	6.03	NS	7.48	6.61	AP
	DO	mg/L	NS	AP	NS	7.36	7.39	9.62
	Water Temperature	celsius	13.8	9.6	NS	16.7	24.3	25.7
	Conductivity	mS/cm	0.113	0.048	NS	0.058	0.058	0.071
	Alkalinity	mg/L	20	15	NS	17	22	22
	Turbidity	NTU	1.9	1.5	NS	2.0	2.1	3.9
	BOD	mg/L	5.9	<2.0	NS	<2.0	<2.0	AP
	TSS	mg/L	27	0.8	NS	4.0	1.6	1.3
	Fecal Coliform (MFC)	FC/100mL	50(e)	28	NS	34	36	75
	NH3 NH4	mg/L	0.056	<0.050	NS	<0.050	0.15	0.069
	NO3 NO2	mg/L	0.080	0.089	NS	0.091	0.12	0.11
	TKN	mg/L	0.36	0.29	NS	0.39	0.48	0.57
	Total Phosphorus	mg/L	0.026	<0.020	NS	<0.020	0.034	0.022
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.82	NS	NS	0.60	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.14	NS	NS	0.084	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	0.014	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	3.8	NS	NS	5.9	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	6.65	6.04	6.26	6.42	5.7	5.94
	DO	mg/L	7.18	AP	8.08	8.28	8.76	9.79
	Water Temperature	celsius	25.5	25.1	22.2	19.4	21.4	12.4
	Conductivity	mS/cm	0.049	AP	AP	AP	AP	0.078
	Alkalinity	mg/L	25	21	22	24	25	24
	Turbidity	NTU	1.8	1.7	1.5	1.7	1.8	1.5
	BOD	mg/L	<2.0	4.6	<2	<2.0	<2.0	<2.0
	TSS	mg/L	0.8	1	0.5	0.7	0.8	<0.50
	Fecal Coliform (MFC)	FC/100mL	130	84	110	100	85	55
	NH3 NH4	mg/L	0.110	<0.050	AP	0.110	<0.050	0.06
	NO3 NO2	mg/L	0.091	0.056	0.072	0.065	0.026	0.081
	TKN	mg/L	0.31	0.40	AP	0.28	0.10	0.27
	Total Phosphorus	mg/L	<0.020	0.046	<0.020	0.02	<0.020	<0.020
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Iron	mg/L	0.28	NS	NS	0.40	0.2	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	<0.050	NS
	Manganese	mg/L	<0.010	NS	NS	0.029	0.025	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	<0.020	NS
	Zinc	mg/L	<0.010	NS	NS	0.024	<0.010	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	<0.00020	NS
	TOC	mg/L	4	NS	NS	3.8	5.3	NS

* No Volatile Organic Compounds,
Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location:	SV-175							
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su	6.41	6.00	7.08	7.01	6.63	AP
	DO	mg/L	9.74	AP	AP	7.19	8.69	9.13
	Water Temperature	celsius	7.1	9.5	16.1	17.3	22.9	25.3
	Conductivity	mS/cm	0.073	0.124	0.080	0.125	0.031	0.082
	Alkalinity	mg/L	36	28	34	31	40	35
	Turbidity	NTU	1.8	1.7	2.7	2.7	2.2	4.8
	BOD	mg/L	AP	4.8	<2.0	<7.7	<2.0	AP
	TSS	mg/L	1.4	1.4	8.1	11.0	6.7	2.1
	Fecal Coliform (MFC)	FC/100mL	120	160	75	210	220	110
	NH3 NH4	mg/L	<0.050	<0.050	0.092	<0.050	0.12	0.082
	NO3 NO2	mg/L	0.086	0.056	0.054	0.12	0.16	0.12
	TKN	mg/L	0.35	0.39	0.49	0.63	0.40	0.77
	Total Phosphorus	mg/L	0.020	<0.020	0.029	0.063	0.055	0.056
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.32	NS	NS	0.72	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.010	NS	NS
	Manganese	mg/L	0.027	NS	NS	0.13	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	4.5	NS	NS	7.6	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su	6.92	5.88	6.44	6.24	6.59	6.21
	DO	mg/L	9.22	AP	8.17	8.92	8.17	9.91
	Water Temperature	celsius	25.6	24.3	22.4	18.8	16.2	11.0
	Conductivity	mS/cm	0.081	AP	AP	AP	NS	0.101
	Alkalinity	mg/L	40	45	34	41	43	39
	Turbidity	NTU	2.5	1.7	1.7	1.5	1.6	1.5
	BOD	mg/L	<2.0	2.4	<2	6.0	<2.0	<2.0
	TSS	mg/L	1.0	1.2	1.2	<0.50	0.5	0.7
	Fecal Coliform (MFC)	FC/100mL	60	150	170	120	180	160
	NH3 NH4	mg/L	0.110	<0.050	<0.050	0.10	0.05	0.05
	NO3 NO2	mg/L	0.130	0.110	0.07	0.093	0.04	0.089
	TKN	mg/L	0.36	0.39	0.22	0.32	0.20	0.30
	Total Phosphorus	mg/L	0.051	0.046	0.037	0.033	0.03	0.029
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.4	NS	NS	0.39	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.042	NS	NS	0.059	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	4.5	NS	NS	5.9	NS	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
Non-radiological Surface Water Data

Sample Location: Blind Duplicate								
Sample Date:		units	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
Monthly Parameters	pH	su						
	DO	mg/L						
	Water Temperature	celsius						
	Conductivity	mS/cm						
	Alkalinity	mg/L	12	22	3.7	<1.0	41	8.1
	Turbidity	NTU	5.6	11	2.7	1.4	2.3	6.1
	BOD	mg/L	AP	6.4	<2.0	<2.0	2.3	AP
	TSS	mg/L	6.0	5.1	4.5	1.1	0.50	7.6
	Fecal Coliform (MFC)	FC/100mL	380	15	35	84	120	180
	NH3 NH4	mg/L	0.11	0.23	0.067	0.11	0.11	0.13
	NO3 NO2	mg/L	2.0	0.36	0.097	0.23	0.15	0.048
	TKN	mg/L	0.23	0.56	0.29	0.38	0.32	0.50
	Total Phosphorus	mg/L	0.16	0.074	<0.020	<0.020	0.054	0.064
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0..010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.87	NS	NS	1.2	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Manganese	mg/L	0.12	NS	NS	0.10	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Zinc	mg/L	0.021	NS	NS	0.028	NS	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	NS	NS
	TOC	mg/L	3.0	NS	NS	5.8	NS	NS
Sample Date:		units	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Monthly Parameters	pH	su						
	DO	mg/L						
	Water Temperature	celsius						
	Conductivity	mS/cm						
	Alkalinity	mg/L	40	21	6.9	41.0	50	<1.0
	Turbidity	NTU	2.2	1.6	4.7	1.5	1.5	<1.0
	BOD	mg/L	<2.0	<2	<2	<2.0	<2.0	<2.0
	TSS	mg/L	0.9	1	5.5	<0.50	<0.50	0.6
	Fecal Coliform (MFC)	FC/100mL	140	110	660	95	200	200
	NH3 NH4	mg/L	0.09	<0.050	<0.050	0.12	0.05	0.06
	NO3 NO2	mg/L	0.120	0.060	0.03	0.08	0.039	0.240
	TKN	mg/L	0.50	0.40	0.26	0.21	0.2	0.18
	Total Phosphorus	mg/L	0.05	0.040	0.052	0.04	0.028	<0.020
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Iron	mg/L	1.0	NS	NS	0.34	1.2	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	<0.050	NS
	Manganese	mg/L	0.12	NS	NS	<0.010	0.072	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	<0.020	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	<0.010	NS
	Mercury	mg/L	<0.00020	NS	NS	<0.00020	<0.00020	NS
	TOC	mg/L	9.6	NS	NS	2.1	4.1	NS

* No Volatile Organic Compounds, Pesticides, or PCBs were detected

Non-radiological Surface Water Monitoring
ESOP and DOE-SR Data Comparison

ESOP Sample Location:	SV-2027				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.131	0.688	6.1	4.09
DO	mg/L	8.572	0.935	10.16	7.39
Water Temperature	celsius	17.964	4.659	23.4	10
TSS	mg/L	2.645	2.394	8.3	0.7
Total Phosphorus	mg/L	0.034	0.014	0.05	<0.020
NO3 NO2	mg/L	0.222	0.033	0.28	0.17
Mercury	mg/L	<LLD	<LLD	<LLD	<LLD
Cadmium	mg/L	<LLD	<LLD	<LLD	<LLD
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	<LLD	<LLD	<LLD	<LLD
Iron	mg/L	0.235	0.067	0.33	0.18
Lead	mg/L	<LLD	<LLD	<LLD	<LLD
Manganese	mg/L	<LLD	<LLD	<LLD	<LLD
Nickel	mg/L	<LLD	<LLD	<LLD	<LLD
Zinc	mg/L	0.015	0.000	0.015	<0.010
TOC	mg/L	4	0.000	4	<2.0

DOE-SR Sample Location:	U3R-1A				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.742	0.82	7.2	4.5
DO	mg/L	9.824	1.11	12	8.4
Water Temperature	celsius	16.333	4.36	22	10
TSS	mg/L	3.418	1.83	6	0.02
Total Phosphorus	mg/L	0.03711	0.01	0.1	0.02
NO3 NO2	mg/L	0.2417	0.02	0.3	0.21
Mercury	mg/L	0.0611	0.05	0.1	0.01
Cadmium	mg/L	0.002	0	0.002	0
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	0.0021	0	0.003	0.002
Iron	mg/L	0.3239	0.09	0.5	0.21
Lead	mg/L	0.00323	0	0.004	0.002
Manganese	mg/L	0.00954	0	0.011	0.007
Nickel	mg/L	0.00207	0	0.003	0.001
Zinc	mg/L	0.03859	0.01	0.049	0.028
TOC	mg/L	2	0.62	3.4	1.4

1. su = standard units
2. mgL = milligrams per Liter
3. LLD = Lower Limit of Detection
4. St. Dev. = Standard Deviation

Non-radiological Surface Water Monitoring
ESOP and DOE-SR Data Comparison

ESOP Sample Location:	SV-324				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.688	0.74	6.80	4.74
DO	mg/L	8.675	0.78	10.01	7.64
Water Temperature	celsius	17.4	6.02	24.20	6.90
TSS	mg/L	4.290	1.41	7.10	2.60
Total Phosphorus	mg/L	0.049	0.01	0.08	<0.020
NO3 NO2	mg/L	0.067	0.05	0.16	0.02
Mercury	mg/L	<LLD	<LLD	<LLD	<LLD
Cadmium	mg/L	<LLD	<LLD	<LLD	<LLD
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	<LLD	<LLD	<LLD	<LLD
Iron	mg/L	1.493	0.52	2.20	0.97
Lead	mg/L	<LLD	<LLD	<LLD	<LLD
Manganese	mg/L	0.035	0.02	0.06	0.04
Nickel	mg/L	<LLD	<LLD	<LLD	<LLD
Zinc	mg/L	<LLD	<LLD	<LLD	<LLD
TOC	mg/L	3.875	1.33	5.20	2.50

DOE-SR Sample Location:	TB-5				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.938	0.99	7.46	4.3
DO	mg/L	10	1.26	11.7	8.4
Water Temperature	celsius	15.86	5.45	23	8
TSS	mg/L	5.5	1.98	9	2
Total Phosphorus	mg/L	<LLD	<LLD	<LLD	<LLD
NO3 NO2	mg/L	0.09	0.04	0.18	0.052
Mercury	mg/L	1.354	2.59	5.24	0.021
Cadmium	mg/L	0.003	0	0.01	0.002
Chromium	mg/L	0.003	0	0.003	0
Copper	mg/L	0.00272	0	0.002	0
Iron	mg/L	2.169	0.72	3.09	1.087
Lead	mg/L	0.0034	0	0.002	0
Manganese	mg/L	0.07253	0.04	0.16	0.015
Nickel	mg/L	0.0109	0.01	0.02	0.003
Zinc	mg/L	0.039	0.01	0.05	0.03
TOC	mg/L	4.742	1.33	6.9	3

1. su = standard units
2. mgL = milligrams per Liter
3. LLD = Lower Limit of Detection
4. St. Dev. = Standard Deviation

Non-radiological Surface Water Monitoring ESOP and DOE-SR Data Comparison

ESOP Sample Location:	SV-325				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.729	0.50	6.4	5.11
DO	mg/L	7.5863	2.99	10.02	0.47
Water Temperature	celsius	18.45	4.65	23.4	9.9
TSS	mg/L	3.1833	1.50	9.2	0.7
Total Phosphorus	mg/L	0.0466	0.06	0.12	<0.020
NO3 NO2	mg/L	0.1308	0.03	0.18	0.09
Mercury	mg/L	<LLD	<LLD	<LLD	<LLD
Cadmium	mg/L	<LLD	<LLD	<LLD	<LLD
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	<LLD	<LLD	<LLD	<LLD
Iron	mg/L	0.42	0.41	0.64	0.26
Lead	mg/L	<LLD	<LLD	<LLD	<LLD
Manganese	mg/L	0.0297	0.04	0.032	<0.010
Nickel	mg/L	<LLD	<LLD	<LLD	<LLD
Zinc	mg/L	0.012	0.01	0.012	<0.010
TOC	mg/L	3.4	1.48	6.3	2

DOE-SR Sample Location:	U3R-4				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.633	0.5	7.4	5.9
DO	mg/L	9.578	2.26	14.64	5.83
Water Temperature	celsius	17.542	5.62	25	9
TSS	mg/L	5.25	3.33	12	1
Total Phosphorus	mg/L	0.0368	0.02	0.086	0.018
NO3 NO2	mg/L	0.1333	0.03	0.2	0.1
Mercury	mg/L	0.0962	0.05	0.144	0.0379
Cadmium	mg/L	<LLD	<LLD	<LLD	<LLD
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	0.0013	0	0.0017	0.001
Iron	mg/L	0.462	0.14	0.648	0.268
Lead	mg/L	0.0025	0	0.0025	0.0025
Manganese	mg/L	0.0206	0.01	0.0325	0.0134
Nickel	mg/L	0.0023	0	0.003	0.001
Zinc	mg/L	0.0166	0	0.01664	0.0166
TOC	mg/L	3.808	0.98	5.2	2.4

1. su = standard units
2. mgL = milligrams per Liter
3. LLD = Lower Limit of Detection
4. St. Dev. = Standard Deviation

Non-radiological Surface Water Monitoring
ESOP and DOE-SR Data Comparison

ESOP Sample Location:	SV-327				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.409	0.57	7.48	5.7
DO	mg/L	8.308	1.01	9.79	7.18
Water Temperature	celsius	19.645	5.73	25.7	9.6
TSS	mg/L	3.85	8.20	27	<.50
Total Phosphorus	mg/L	0.0296	0.01	0.046	<0.020
NO3 NO2	mg/L	0.0801	0.03	0.12	0.026
Mercury	mg/L	<LLD	<LLD	<LLD	<LLD
Cadmium	mg/L	<LLD	<LLD	<LLD	<LLD
Chromium	mg/L	<LLD	<LLD	<LLD	<LLD
Copper	mg/L	<LLD	<LLD	<LLD	<LLD
Iron	mg/L	0.525	0.24	0.82	0.28
Lead	mg/L	<LLD	<LLD	<LLD	<LLD
Manganese	mg/L	0.0843	0.06	0.14	<0.010
Nickel	mg/L	<LLD	<LLD	<LLD	<LLD
Zinc	mg/L	0.019	0.01	0.024	<0.010
TOC	mg/L	4.375	1.02	5.9	3.8

DOE-SR Sample Location:	SC-4				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.992	0.37	7.6	6.4
DO	mg/L	9.55	2.07	13.2	6.27
Water Temperature	celsius	18	6.86	26	7
TSS	mg/L	4.417	3.75	13	1
Total Phosphorus	mg/L	0.037	0.02	0.069	0.014
NO3 NO2	mg/L	0.0971	0.05	0.23	0.038
Mercury	mg/L	0.0678	0.04	0.119	0.03
Cadmium	mg/L	0.0006	0	0.001	0.00015
Chromium	mg/L	0.001	0	0.001	0.001
Copper	mg/L	0.0033	0	0.0055	0.0009
Iron	mg/L	0.5743	0.23	1.089	0.3805
Lead	mg/L	0.0049	0	0.0049	0.0049
Manganese	mg/L	0.0609	0.03	0.1393	0.0331
Nickel	mg/L	0.003	0	0.004	0.002
Zinc	mg/L	0.0283	0.01	0.0376	0.019
TOC	mg/L	4.45	1.07	7.1	2.8

1. su = standard units
2. mgL = milligrams per Liter
3. LLD = Lower Limit of Detection
4. St. Dev. = Standard Deviation

2.4.5 Summary Statistics
Non-radiological Surface Water Monitoring

SV-2027					
	units	Maximum	Median	Mean	St. Dev.
pH	su	6.1	5.245	5.131	0.688
DO	mg/L	10.16	8.39	8.572	0.935
Water Temperature	celsius	23.4	19.7	17.964	4.659
Conductivity	mS/cm	1.165	0.066	0.211	0.421
Alkalinity	mg/L	<LLD	<LLD	<LLD	<LLD
Turbidity	NTU	3.4	1.55	1.680	0.681
BOD 5	mg/L	5.1	3.4	3.380	1.276
TSS	mg/L	8.3	1.7	2.645	2.394
Fecal Coliform (MFC)	FC/100mL	300	100	130.545	69.213
NH3 NH4	mg/L	0.19	0.125	0.123	0.059
NO3 NO2	mg/L	0.28	0.22	0.222	0.033
TKN	mg/L	0.94	0.31	0.374	0.259
Total Phosphorus	mg/L	0.05	0.028	0.034	0.014
Iron	mg/L	0.33	0.215	0.235	0.067
Manganese	mg/L	<LLD	<LLD	<LLD	<LLD
Zinc	mg/L	0.015	0.015	0.015	0.000
TOC	mg/L	4	4	4.000	0.000

SV-324					
	units	Maximum	Median	Mean	St. Dev.
pH	su	6.80	5.97	5.69	0.74
DO	mg/L	10.01	8.55	8.68	0.78
Water Temperature	celsius	24.20	18.80	17.40	6.02
Conductivity	mS/cm	0.07	0.04	0.04	0.01
Alkalinity	mg/L	9.10	5.10	5.80	1.63
Turbidity	NTU	7.90	3.80	4.23	1.59
BOD 5	mg/L	3.50	3.50	3.50	0.00
TSS	mg/L	7.10	4.00	4.29	1.41
Fecal Coliform (MFC)	FC/100mL	350.00	130.00	122.36	101.98
NH3 NH4	mg/L	0.21	0.09	0.11	0.06
NO3 NO2	mg/L	0.16	0.05	0.07	0.05
TKN	mg/L	0.51	0.28	0.28	0.11
Total Phosphorus	mg/L	0.08	0.05	0.05	0.01
Iron	mg/L	2.20	1.40	1.49	0.52
Manganese	mg/L	0.06	0.04	0.04	0.02
Zinc	mg/L	<LLD	<LLD	<LLD	<LLD
TOC	mg/L	5.20	3.90	3.88	1.33

Summary Statistics
Non-radiological Surface Water Monitoring

SV-326					
	units	Maximum	Median	Mean	St. Dev.
pH	su	7.04	5.95	6.04	0.56
DO	mg/L	9.76	8.58	8.52	0.89
Water Temperature	celsius	26.70	21.20	18.73	6.93
Conductivity	mS/cm	0.14	0.07	0.08	0.03
Alkalinity	mg/L	28.00	17.00	16.97	5.44
Turbidity	NTU	9.80	4.20	4.79	2.04
BOD 5	mg/L	4.90	3.60	3.60	1.84
TSS	mg/L	6.30	1.80	2.06	1.50
Fecal Coliform (MFC)	FC/100mL	310.00	120.00	157.09	111.06
NH3 NH4	mg/L	0.16	0.12	0.11	0.04
NO3 NO2	mg/L	2.10	1.10	1.29	0.37
TKN	mg/L	0.66	0.35	0.36	0.13
Total Phosphorus	mg/L	0.22	0.17	0.15	0.06
Iron	mg/L	1.70	1.00	1.12	0.41
Manganese	mg/L	0.11	0.09	0.08	0.04
Zinc	mg/L	0.04	0.03	0.03	0.01
TOC	mg/L	5.90	5.00	4.65	1.48

SV-325					
	units	Maximum	Median	Mean	St. Dev.
pH	su	6.40	5.77	5.73	0.50
DO	mg/L	10.02	8.26	7.59	2.99
Water Temperature	celsius	23.40	20.00	18.45	4.65
Conductivity	mS/cm	0.04	0.02	0.03	0.01
Alkalinity	mg/L	3.70	3.20	2.96	0.63
Turbidity	NTU	4.80	2.45	2.68	1.04
BOD 5	mg/L	7.10	6.60	5.40	2.09
TSS	mg/L	9.20	2.65	3.18	2.42
Fecal Coliform (MFC)	FC/100mL	280.00	125.00	139.33	81.94
NH3 NH4	mg/L	0.15	0.08	0.09	0.03
NO3 NO2	mg/L	0.18	0.13	0.13	0.03
TKN	mg/L	0.43	0.30	0.31	0.07
Total Phosphorus	mg/L	0.12	0.04	0.05	0.03
Iron	mg/L	0.64	0.39	0.42	0.17
Manganese	mg/L	0.03	0.03	0.03	0.00
Zinc	mg/L	0.01	0.01	0.01	0.00
TOC	mg/L	6.30	2.65	3.40	1.98

Summary Statistics
Non-radiological Surface Water Monitoring

SV-2047					
	units	Maximum	Median	Mean	St. Dev.
pH	su	7.29	6.03	6.18	0.54
DO	mg/L	10.01	8.74	8.52	0.96
Water Temperature	celsius	26.20	21.80	19.25	6.22
Conductivity	mS/cm	0.12	0.06	0.07	0.04
Alkalinity	mg/L	23.00	21.00	18.00	6.78
Turbidity	NTU	5.20	2.90	3.03	0.92
BOD 5	mg/L	3.00	2.55	2.55	0.64
TSS	mg/L	8.80	1.80	2.56	2.47
Fecal Coliform (MFC)	FC/100mL	150.00	80.00	78.00	38.11
NH3 NH4	mg/L	0.15	0.08	0.09	0.04
NO3 NO2	mg/L	0.21	0.15	0.14	0.03
TKN	mg/L	0.84	0.36	0.38	0.19
Total Phosphorus	mg/L	0.07	0.03	0.04	0.01
Iron	mg/L	0.84	0.51	0.58	0.17
Manganese	mg/L	0.06	0.04	0.04	0.02
Zinc	mg/L	<LLD	<LLD	<LLD	<LLD
TOC	mg/L	4.60	4.00	4.00	0.50

SV-327					
	units	Maximum	Median	Mean	St. Dev.
pH	su	6.41	0.57	6.26	0.54
DO	mg/L	8.31	1.01	8.18	1.01
Water Temperature	celsius	19.65	5.73	21.40	5.73
Conductivity	mS/cm	0.07	0.02	0.06	0.02
Alkalinity	mg/L	21.55	3.21	22.00	3.21
Turbidity	NTU	1.95	0.68	1.80	0.68
BOD 5	mg/L	5.25	0.92	5.25	0.92
TSS	mg/L	3.85	8.20	0.90	8.20
Fecal Coliform (MFC)	FC/100mL	71.55	33.71	75.00	33.71
NH3 NH4	mg/L	0.09	0.04	0.09	0.04
NO3 NO2	mg/L	0.08	0.03	0.08	0.03
TKN	mg/L	0.35	0.13	0.34	0.13
Total Phosphorus	mg/L	0.03	0.01	0.03	0.01
Iron	mg/L	0.53	0.24	0.50	0.24
Manganese	mg/L	0.08	0.06	0.08	0.06
Zinc	mg/L	0.02	0.01	0.02	0.01
TOC	mg/L	4.38	1.02	3.90	1.02

Summary Statistics
Non-radiological Surface Water Monitoring

SV-175					
	units	Maximum	Median	Mean	St. Dev.
pH	su	7.08	6.44	6.49	0.40
DO	mg/L	9.91	8.92	8.79	0.85
Water Temperature	celsius	25.60	18.05	18.04	6.34
Conductivity	mS/cm	0.13	0.08	0.09	0.03
Alkalinity	mg/L	45.00	37.50	37.17	5.02
Turbidity	NTU	4.80	1.75	2.20	0.93
BOD 5	mg/L	6.00	4.80	4.40	1.83
TSS	mg/L	11.00	1.40	3.21	3.62
Fecal Coliform (MFC)	FC/100mL	220.00	155.00	144.58	49.33
NH3 NH4	mg/L	0.12	0.09	0.09	0.03
NO3 NO2	mg/L	0.16	0.09	0.09	0.04
TKN	mg/L	0.77	0.38	0.40	0.16
Total Phosphorus	mg/L	0.06	0.04	0.04	0.01
Iron	mg/L	0.72	0.40	0.46	0.18
Manganese	mg/L	0.13	0.05	0.06	0.05
Zinc	mg/L	<LLD	<LLD	<LLD	<LLD
TOC	mg/L	7.60	5.20	5.63	1.47

Blind Duplicate					
	units	Maximum	Median	Mean	St. Dev.
pH	su	NS	NS	NS	NS
DO	mg/L	NS	NS	NS	NS
Water Temperature	celsius	NS	NS	NS	NS
Conductivity	mS/cm	NS	NS	NS	NS
Alkalinity	mg/L	50.00	21.50	24.57	17.07
Turbidity	NTU	11.00	2.30	3.69	2.97
BOD 5	mg/L	6.40	2.30	3.20	2.86
TSS	mg/L	7.60	1.10	3.03	2.71
Fecal Coliform (MFC)	FC/100mL	660.00	130.00	184.92	177.28
NH3 NH4	mg/L	0.23	0.11	0.11	0.05
NO3 NO2	mg/L	2.00	0.11	0.29	0.55
TKN	mg/L	0.56	0.31	0.34	0.13
Total Phosphorus	mg/L	0.16	0.05	0.06	0.04
Iron	mg/L	1.20	0.94	0.85	0.37
Manganese	mg/L	0.12	0.12	0.11	0.01
Zinc	mg/L	0.03	0.02	0.02	0.00
TOC	mg/L	9.60	4.40	5.13	3.37

3.1 Radiological Surveillance of Surface Soils On and Adjacent to SRS

3.1.1 Summary

The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) provides independent nonregulatory evaluation of Department of Energy – Savannah River (DOE-SR) environmental monitoring programs. ESOP personnel independently evaluated surface soils for select gamma-emitting radionuclides, a specified Target Analyte List (TAL) for metals, and specific radionuclides. These soil samples were collected to determine if Savannah River Site (SRS) activities may have impacted areas outside of the site boundaries.

The ESOP surface soil monitoring project changed in 2004 to include more randomized coverage of perimeter soils within 50 miles of SRS and background soils at greater than 50 miles. This sampling program was implemented to allow future probabilistic comparisons of the SRS perimeter and South Carolina (SC) background contaminant levels in soils. ESOP collected 12 perimeter samples within the 50-mile radius of SRS and 12 background samples outside of the 50-mile radius. No samples were collected within the SRS boundary. Additionally, one non-random sample (AKN-254) was collected in the Kitchings Mill area of Aiken County (Map 7, section 3.1.2). The random sampling locations were chosen based on a quadrant system established by the U.S. Department of Interior on a 7.5' topographical map of South Carolina revision 10/92.

ESOP started a random sampling regime to determine if elevated levels of contaminants were attributed to SRS activities. Averages for background ("B") samples were subtracted from perimeter ("P") samples to determine the SRS off-site 50-mile perimeter random environmental concentrations above SC background. Statistical analyses were conducted to determine if the SRS perimeter and SC background radionuclide populations are significantly different. These SRS perimeter minus SC background ("E-B") averages were used to determine if data collected by ESOP were comparable to DOE-SR data.

RESULTS AND DISCUSSION

<u>Radiological</u>

Potassium-40 (K-40), Cobalt-60 (Co-60), Cesium-137 (Cs-137), Europium-155 (Eu-155), Lead-212 and -214 (Pb-212, Pb-214), Radium-226 (Ra-226), Actinium-228 (Ac-228), and Thorium-234 (Th-234) were the only gamma-emitting radionuclides detected among perimeter and background samples. All other gamma-emitting radionuclides were below the Minimum Detectable Activity (MDA). Gamma data for radionuclides where at least one detect was recorded for either the background or perimeter location is given in section 3.1.3. This data represents all random and non-random data collected from every sampling location and can be considered to be a grand average for each radionuclide. All radiological data is located in section 3.1.3.

Uranium was also detected in perimeter and background samples. The highest concentration of U-234 (3.40 pCi/g with an uncertainty of 0.63 pCi/g) was collected in a perimeter sample near

North, SC. Additionally, the highest concentration of U-238 (0.79 pCi/g with an uncertainty of 0.17 pCi/g) was detected in the same location.

Non-radiological

Eighteen of the 27 metals from the TAL had a detect either in a perimeter or background sample. Data for metal concentrations detected in random and non-random ESOP samples is given in section 3.1.3. All nonradiological data is located in section 3.1.3.

Statistical Summary

Summary statistics are given in section 3.1.4.

Background sample averages were subtracted from perimeter sample averages in order to determine the SRS random environmental concentrations above background. This “E-B” average was used to calculate the SRS environmental concentrations above background. If this number was greater than zero and the radionuclide was associated with SRS, then further statistical analysis was conducted. Statistical analysis of data between ESOP and DOE-SR cannot be done since DOE-SR does not do random sampling. However, since ESOP collects random samples based on a quadrant system, a statistical comparison can be done between SRS perimeter and SC background samples. This comparison can be used to determine the statistical significance of any differences encountered between ESOP perimeter and background samples. Once this significance is determined, then ESOP data can be compared to DOE-SR data using standard deviation.

When all of the random and non-random samples were averaged, only four radionuclides had an “E-B” average greater than zero (Pb-212, Pb-214, Ra-226, and Ac-228). These averages were calculated to provide a more accurate characterization of the contaminant concentrations throughout the sampling area. The random data “E-B” averages were greater than zero for the same radionuclides mentioned above, but also included Cs-137 (section 3.1.3). DOE-SR did not conduct analysis of Pb-212, Pb-214, Ra-226, and Ac-228. These are naturally occurring radioactive materials (NORM) and any detected levels may result from the decay of natural products. Cesium-137 is a fission product and any elevated levels could be related to anthropogenic activity. Further statistical analysis of Cs-137 was done using ESOP random sampling averages. The hypothesis that the DOE-SR perimeter random soil Cs-137 population had the same shape and location as the South Carolina random background Cs-137 population was not disproved by the application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level (Michigan 2002; EPA 2000). There were not enough samples collected to perform a statistical analysis on Uranium samples collected by ESOP. Since a statistical significance was established between SRS perimeter and SC background sample data, then the “E-B” ESOP average could be compared to DOE-SR data. The ESOP random “E-B” average for Cs-137 was 0.0077 pCi/g. The DOE-SR Cs-137 average was 0.231 pCi/g with an uncertainty of 0.219 pCi/g (WSRC 2005). The ESOP average for Cs-137 falls within one Standard Deviation (SD) of the DOE-SR data. Therefore, the data reported by DOE-SR is comparable to the data reported by ESOP. DOE-SR did not collect samples for metals analysis, so no comparison to ESOP metals data can be made. The ESOP data was used to calculate “E-B” averages from the “detects only” data for metals. Only two metals had “E-B” averages that were greater than zero, copper (Cu) and calcium (Ca) (section 3.1.3). Both of these averages were well below the Region 9 Preliminary Remediation Goals (PRGs) for residential soil established by the Environmental Protection Agency (EPA).

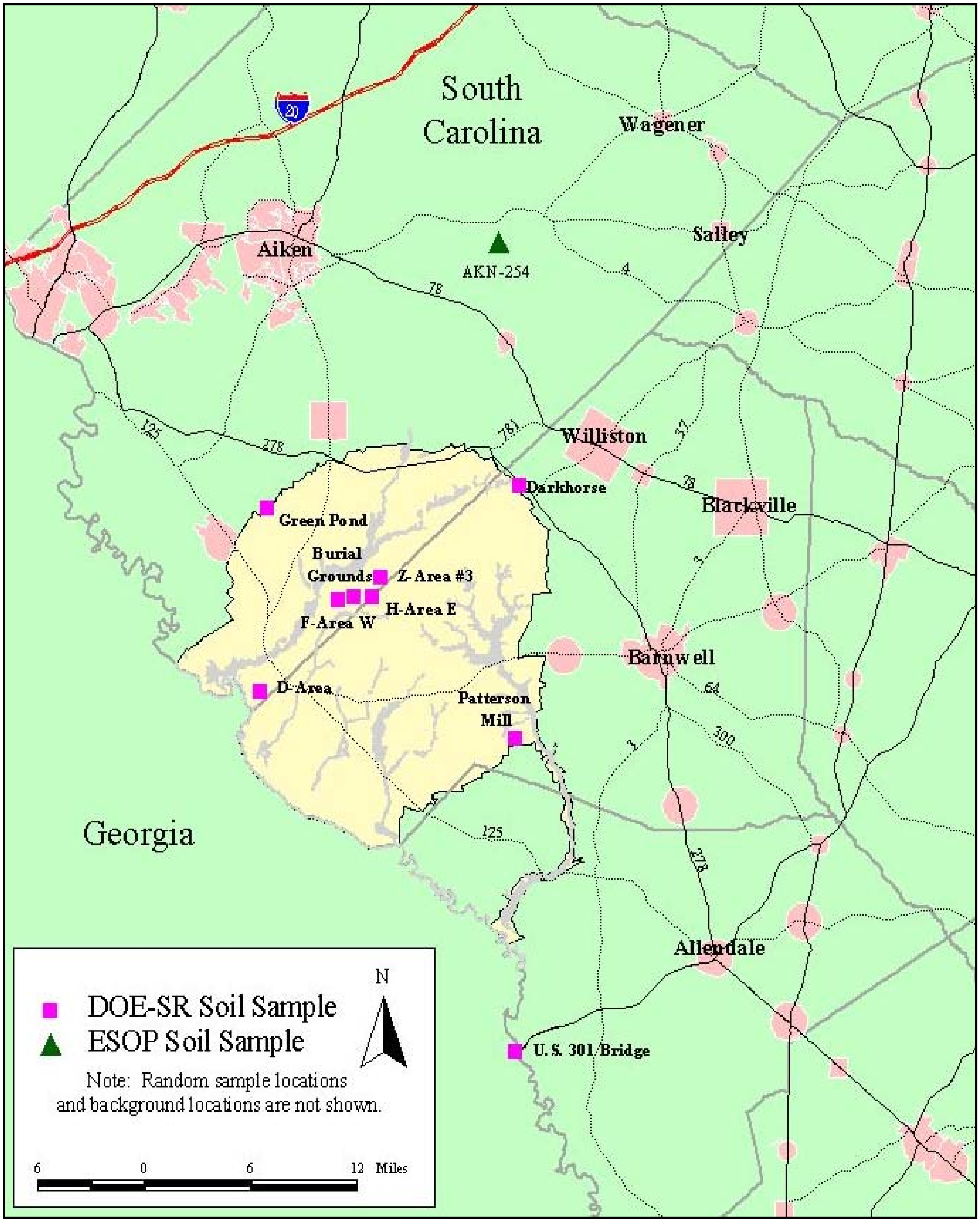
CONCLUSIONS AND RECOMMENDATIONS

ESOP incorporated a random sampling regime in order to conduct statistical tests to determine if differences in concentrations between perimeter samples and background samples were significant. The primary objective was to determine if the SRS 50-mile perimeter samples were significantly greater than the SC background.

The hypothesis that the 50-mile SRS population (E) is not more contaminated that the SC background population (B) was not rejected for the radionuclides tested. The ESOP "E-B detects only" average was within one SD of the DOE-SR data. Cesium-137 within the 50-mile SRS perimeter is not significantly different than the SC background at the 0.05 level. Based on this data, there is statistical evidence that SRS operations are not impacting other areas of South Carolina. Any observed elevated levels of contaminants may be due to fallout from past events or activities from other facilities. Additionally, differences in metal concentrations may be attributed to soil composition. Random sample collection from a variety of background locations may provide a better characterization of the soil types throughout the state.

ESOP will continue to conduct random sampling in addition to non-random sampling. The random sampling will allow more probabilistic tests on SRS perimeter and SC background samples. The possibility of comparing elevated maximums across SC with nuclear fallout radioactive deposition tracks may be achieved at some time in the future.

3.1.2
Map 7. Radiological Surveillance of Surface Soils



3.1.3 Data
Radiological Surveillance of Soils Data

Radiological Surveillance of Soils
All SRS Perimeter and SC Background Samples for Gamma and Metals

Gamma

		Perimeter Samples(<50 Miles)			Background Samples (>50 Miles)			E-B	E-B
		AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	AVERAGE
K-40	D Only	4.33	5.82	2.16	10.12	10.74	6.30	-5.79	-4.14
	D + 0.5 mda ND	2.09	4.33	0.28	9.28	10.65	5.41	-7.19	-5.14
Cs-137	D Only	0.1579	0.1248	0.0998	0.1585	0.0935	0.1583	-0.0006	-0.0585
	D + 0.5 mda ND	0.1467	0.1262	0.0930					
Eu-155	D Only	0.2499	0.1200	0.2798	0.3494	0.0270	0.3491	-0.0995	-0.0693
	D + 0.5 mda ND	0.0963	0.1146	0.0332	0.1088	0.1457	0.0334	-0.0125	-0.0002
Pb-212	D Only	0.8077	0.6900	0.4954	0.5468	0.4370	0.3523	0.26	0.14
	D + 0.5 mda ND	0.6853	0.6971	0.3843	0.3683	0.4370	0.2629	0.32	0.12
Pb-214	D Only	0.9407	0.5482	0.7501	0.7569	0.4246	0.7475	0.1838	0.0026
	D + 0.5 mda ND								
Ra-226	D Only	1.93	1.09	1.59	1.85	0.66	1.63	0.0787	-0.0440
	D + 0.5 mda ND				1.42	0.95	1.47	-1.4248	-1.4680
Ac-228	D Only	1.15	0.50	1.02	1.05	0.40	1.07	0.0994	-0.0530
	D + 0.5 mda ND	0.84	0.57	0.93	0.80	0.57	0.83	0.0373	0.0987
Th-234	D Only	0.46	NA	NA	0.49	(1)	0.49	-0.0334	
	D + 0.5 mda ND	0.17	0.10	0.16	0.17	0.10	0.15	-0.0075	0.0096

Metals

	Perimeter			Background			E-B	E-B
	AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	MEDIAN
Al:	7846.15	7717.58	5200.00	13411.67	11686.50	8700.00	-5565.51	-3500.00
Ba:	51.82	48.86	45.50	61.84	71.94	34.00	-10.02	11.50
Be:	0.67	0.32	0.69	0.86	0.51	0.71	-0.19	-0.02
Ca:	400.92	568.32	102.00	412.08	421.24	285.00	-11.17	-183.00
Cr:	8.83	9.58	4.60	14.35	14.00	8.75	-5.52	-4.15
Co:	6.63	4.54	5.40	10.54	7.75	7.50	-3.92	-2.10
Cu:	6.84	10.81	2.80	5.38	7.05	2.30	1.47	0.50
Fe:	5073.08	5719.53	3000.00	9412.73	9108.18	5700.00	-4339.65	-2700.00
Pb:	13.84	11.41	10.50	20.20	14.38	13.00	-6.36	-2.50
Mg:	604.08	1353.45	140.00	949.50	1630.08	215.00	-345.42	-75.00
Mn:	151.41	230.45	32.00	248.76	429.35	54.00	-97.35	-22.00
Mo:	3.20	NA	3.20					
Ni:	4.77	2.01	4.30	7.09	6.10	4.15	-2.32	0.15
K:	691.25	1421.23	145.00	937.78	1302.59	260.00	-246.53	-115.00
Na:	25.25	4.86	26.00	44.00	41.93	26.00	-18.75	0.00
Ti:	228.69	416.17	100.00	532.25	701.09	165.00	-303.56	-65.00
V:	13.75	12.45	9.25	20.20	17.56	15.50	-6.45	-6.25
Zi:	11.98	10.85	7.70	19.37	19.16	8.90	-7.40	-1.20

Radiological Surveillance of Soils
All Random SRS Perimeter and SC Background Samples for Gamma and Metals

Gamma

		Perimeter Samples(<50 Miles)			Background Samples (>50 Miles)			E-B	E-B
		AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	MEDIAN
K-40	D Only	5.00	6.25	2.95	10.12	10.74	6.30	-5.12	-3.35
	D + 0.5 mda ND	2.18	4.51	0.26	9.28	10.65	5.41	-7.10	-5.15
Cs-137	D Only	0.1662	0.1274	0.1065	0.1585	0.0935	0.1583	0.0077	-0.0518
	D + 0.5 mda ND	0.1533	0.1294	0.0998					
Eu-155	D Only	0.3160	0.1535	0.3160	0.3494	0.0270	0.3491	-0.0335	-0.0332
	D + 0.5 mda ND	0.0945	0.1195	0.0328	0.1088	0.1457	0.0334	-0.0143	-0.0006
Pb-212	D Only	0.6759	0.5626	0.4399	0.5468	0.4370	0.3523	0.1291	0.0876
	D + 0.5 mda ND	0.5653	0.5707	0.3514	0.3683	0.4370	0.2629	0.1969	0.0885
Pb-214	D Only	0.8605	0.4867	0.7462	0.7569	0.4246	0.7475	0.1037	-0.0014
	D + 0.5 mda ND								
Ra-226	D Only	1.7667	0.9714	1.5055	1.8470	0.6601	1.6330	-0.0803	-0.1275
	D + 0.5 mda ND				1.4248	0.9489	1.4680	-1.4248	-1.4680
Ac-228	D Only	1.060	0.429	1.003	1.046	0.404	1.071	0.014	-0.068
	D + 0.5 mda ND	0.898	0.543	0.961	0.799	0.566	0.834	0.099	0.127
Th-234	D Only	0.461	NA	0.461	0.494	NA	0.494	-0.033	-0.033
	D + 0.5 mda ND	0.169	0.102	0.158	0.175	0.104	0.147	-0.006	0.011

Metals

	Perimeter			Background			E-B	E-B
	AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	MEDIAN
Al	7841.67	8060.73	4200.00	13411.67	11686.50	8700.00	-5570.00	-4500.00
Ba	52.80	51.12	50.00	61.84	71.94	34.00	-9.04	16.00
Be	0.67	0.32	0.69	0.86	0.51	0.71	-0.19	-0.02
Ca	434.27	583.60	140.00	412.08	421.24	285.00	**22.19**	-145.00
Cr	8.81	10.05	4.40	14.35	14.00	8.75	-5.54	-4.35
Co	6.63	4.54	5.40					
Cu	7.52	11.68	2.70	5.38	7.05	2.30	**2.14**	0.40
Fe	5037.50	5972.35	2800.00	9412.73	9108.18	5700.00	-4375.23	-2900.00
Pb	14.04	12.08	10.00	20.20	14.38	13.00	-6.16	-3.00
Mg	642.75	1406.11	155.00	949.50	1630.08	215.00	-306.75	-60.00
Mn	163.20	236.57	42.00	248.76	429.35	54.00	-85.56	-12.00
Mo	3.2 (1)	NA	NA					
Ni	5.13	1.94	4.50	7.09	6.10	4.15	-1.95	0.35
K	770.00	1516.14	150.00	937.78	1302.59	260.00	-167.78	-110.00
Na	25.25	4.86	26.00	44.00	41.93	26.00	-18.75	0.00
Ti	232.75	434.41	94.50	532.25	701.09	165.00	-299.50	-70.50
V	13.91	13.04	7.50	20.20	17.56	15.50	-6.29	-8.00
Zi	12.43	11.26	8.40	19.37	19.16	8.90	-6.95	-0.50

1. Only one detect for Molybdenum

Radiological Surveillance of Soils
Gamma Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E1052004	E2B3	E3X2	E4061004
Date Collected	20 MAY 04	07 May 04	07 MAY 04	10 JUN 04
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<1.226E+00	<6.064E-013	<4.824E-01	<1.329E-01
Na-22	<2.629E-02	<2.863E-02	<2.116E-02	<3.305E-02
K-40	<5.544E-01	**1.306E+00**	<1.811E-01	<2.832E-01
plus or minus 2 SD		**3.710E-01**		
MDA		**2.345E-01**		
Mn-54	<4.071E-02	<3.269E-02	<2.796E-02	<6.221E-02
Co-58	<4.960E-01	<5.568E-02	<4.041E-02	<5.736E-01
Co-60	<2.309E-02	<2.723E-02	<1.893E-02	<3.011E-02
Zn-65	<1.377E-01	<8.812E-02	<5.618E-02	<2.026E-01
Y-88	<1.849E-01	<4.485E-02	<3.308E-02	<2.222E-01
Zr-95	<1.250E+00	<1.109E-01	<9.047E-02	<1.640E+00
Ru-103	>8hle	<1.029E-01	<8.188E-02	>8hle
Sb-125	<7.052E-02	<7.149E-02	<5.757E-02	<9.790E-02
I-131	>8hle	>8hle	>8hle	>8hle
Cs-134	<3.055E-02	<3.485E-02	<2.500E-02	<4.384E-02
Cs-137	**1.104E-01**	**2.911E-01**	**3.330E-01**	**1.065E-01**
plus or minus 2 SD	**2.395E-02**	**3.954E-02**	**4.239E-02**	**3.169E-02**
MDA	**2.071E-02**	**2.741E-02**	**2.220E-02**	**3.438E-02**
Ce-144	<2.441E-01	<1.765E-01	<1.473E-01	<3.536E-01
Eu-152	<4.081E-02	<5.092E-02	<4.229E-02	<6.233E-02
Eu-154	<2.927E-02	<3.6096E-02	<3.041E-02	<4.470E-02
Eu-155	<5.672E-02	<5.548E-02	**2.798E-01**	**3.521E-01**
plus or minus 2 SD			**5.329E-02**	**3.521E-01**
MDA			**4.419E-02**	**5.996E-02**
Pb-212	**2.901E-01**	**3.843E-01**	**3.184E-01**	**1.798E+00**
plus or minus 2 SD	**4.125E-02**	**4.696E-02**	**3.840E-02**	**1.602E-01**
MDA	**1.757E-02**	**2.717E-02**	**2.272E-02**	**2.900E-02**
Pb-214	**4.775E-01**	**1.881E+00**	**8.211E-01**	**1.250E+00**
plus or minus 2 SD	**4.360E-02**	**1.696E-01**	**8.346E-02**	**8.660E-02**
MDA	**3.819E-02**	**5.004E-02**	**3.870E-02**	**5.634E-02**
Ra-226	**1.099E+00**	**3.390E+00**	**1.422E+00**	**1.781E+00**
plus or minus 2 SD	**4.022E-01**	**6.868E-01**	**5.061E-01**	**5.741E-01**
MDA	**3.910E-01**	**5.139E-01**	**3.967E-01**	**6.031E-01**
Ac-228	<1.426E-01	**1.018E+00**	**1.449E+00**	**1.704E+00**
plus or minus 2 SD		**9.820E-02**	**1.016E-01**	**1.370E-01**
MDA		**1.015E-01**	**7.505E-02**	**1.164E-01**
Th-234	<2.649E-01	<3.190E-01	<3.380E-01	<3.191E-01
plus or minus 2 SD				
MDA				
Am-241	<3.509E-02	<6.352E-02	<5.316E-02	<5.869E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Gamma Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E5C	E6061604	E7061604	E8122004
Date Collected	07 MAY 05	16 JUN 04	16 JUN 04	20 DEC 04
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<3.268E-01	<8.614E+00	<1.211E+01	<7.521E-01
Na-22	<1.620E-02	<2.645E-02	<3.501E-01	<2.275E-02
K-40	<3.056E-01	<4.410E-01	**2.952E+00**	<4.985E-01
plus or minus 2 SD			**5.227E-01**	
MDA			**2.437E-01**	
Mn-54	<1.845E-02	<4.169E-02	<5.808E-02	<2.456E-02
Co-58	<3.058E-02	<3.778E-01	<4.894E-01	<5.672E-02
Co-60	<1.504E-02	<2.296E-02	<3.323E-02	<2.063E-02
Zn-65	<4.628E-02	<1.117E-01	<1.604E-01	<7.547E-02
Y-88	<2.447E-02	<1.529E-01	<1.768E-01	<3.933E-02
Zr-95	<6.420E-02	<1.050E+00	<1.390E+00	<1.216E-01
Ru-103	<5.787E-02	<4.146E+00	<5.808E+00	<1.589E-01
Sb-125	<4.006E-02	<6.607E-02	<9.263E-02	<5.565E-02
I-131	>8hle	>8hle	>8hle	>8hle
Cs-134	<1.643E-02	<2.921E-02	<3.866E-02	<2.338E-02
Cs-137	**9.221E-02**	**9.042E-02**	**4.224E-01**	**1.386E-02**
plus or minus 2 SD	**2.200E-02**	**3.050E-02**	**5.493E-02**	**1.701E-02**
MDA	**1.469E-02**	**2.347E-02**	**2.944E-02**	**2.059E-02**
Ce-144	<9.536E-02	<2.551E-01	<3.075E-01	<1.464E-01
Eu-152	<2.756E-02	<4.421E-02	<5.627E-02	<3.838E-02
Eu-154	<1.972E-02	<3.213E-02	<4.015E-02	<2.805E-02
Eu-155	<3.911E-02	<6.329E-02	<7.479E-02	<5.211E-02
plus or minus 2 SD				
MDA				
Pb-212	**5.899E-02**	**1.075E+00**	**4.954E-01**	<1.596E-02
plus or minus 2 SD	**1.439E-02**	**9.822E-02**	**6.290E-02**	
MDA	**1.419E-02**	**1.977E-02**	**2.311E-02**	
Pb-214	**3.181E-01**	**5.859E-01**	**4.310E-01**	**5.305E-01**
plus or minus 2 SD	**4.464E-02**	**5.029E-02**	**5.386E-02**	**4.556E-02**
MDA	**2.674E-02**	**3.956E-02**	**5.477E-02**	**3.594E-02**
Ra-226	**7.043E-01**	**7.814E-01**	**1.589E+00**	**1.211E+00**
plus or minus 2 SD	**2.549E-01**	**3.793E-01**	**6.068E-01**	**3.920E-01**
MDA	**2.674E-01**	**4.121E-01**	**5.097E-01**	**3.817E-01**
Ac-228	**4.029E-01**	**9.889E-01**	<1.999E-01	**4.998E-01**
plus or minus 2 SD	**4.768E-02**	**8.273E-02**		**6.722E-02**
MDA	**5.036E-02**	**7.751E-02**		**7.497E-02**
Th-234	**4.605E-01**	<3.127E-01	<3.733E-01	<2.778E-01
plus or minus 2 SD	**1.764E-01**			
MDA	**1.571E-01**			
Am-241	<3.296E-02	<4.176E-02	<4.741E-02	<3.533E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Gamma Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E9061604	E10122004	E11122004	E12093004HK	AKN-254
Date Collected	16 JUN 04	20 DEC 04	20 DEC 04	24 SEP 04	28 OCT 04
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g	pCi/L
Be-7	<9.727E+00	<1.559E+00	<1.405E+00	<3.231E-01	<2.004E+00
Na-22	<3.145E-02	<2.519E-02	<3.926E-02	<3.045E-02	<3.176E-02
K-40	**3.300E+00**	<1.800E-01	**1.366E+00**	**1.606E+01**	**1.021E+00**
plus or minus 2 SD	**4.200E-01**		**5.381E-01**	**1.133E+00**	**3.538E-01**
MDA	**2.017E-01**		**3.198E-01**	**2.198E-01**	**2.602E-01**
Mn-54	<4.750E-02	<3.334E-02	<4.978E-02	<2.874E-02	<3.820E-02
Co-58	<3.899E-01	<1.012E-01	<1.095E-01	<3.608E-02	<1.283E-01
Co-60	<2.401E-02	<2.401E-02	<3.509E-02	<2.707E-02	<2.715E-02
Zn-65	<1.464E-01	<8.341E-02	<1.395E-01	<7.207E-02	<1.264E-01
Y-88	<1.702E-01	<6.314E-02	<7.199E-02	<2.422E-02	<6.893E-02
Zr-95	<1.087E+00	<2.529E-01	<2.322E-01	<6.780E-02	<3.476E-01
Ru-103	<4.400E+00	<4.052E-01	<2.865E-01	<4.280E-02	<5.077E-01
Sb-125	<7.131E-02	<6.861E-02	<1.010E-01	<6.772E-02	<7.956E-02
I-131	>8hle	>8hle	>8hle	<7.553E-01	>8hle
Cs-134	<3.251E-02	<2.583E-02	<4.447E-02	<2.672E-02	<3.764E-02
Cs-137	<2.316E-02	**9.304E-02**	**8.725E-02**	**1.881E-01**	**6.678E-02**
plus or minus 2 SD		**2.519E-02**	**3.214E-02**	**4.338E-02**	**2.077E-02**
MDA		**2.578E-02**	**3.739E-02**	**2.877E-02**	**3.102E-02**
Ce-144	<2.557E-01	<1.929E-01	<2.652E-01	<1.431E-01	<2.440E-01
Eu-152	<4.502E-02	<4.689E-02	<7.085E-02	<4.788E-02	<5.767E-02
Eu-154	<3.263E-02	<3.368E-02	<5.049E-02	<3.330E-02	<4.107E-02
Eu-155	<4.635E-01	<6.639E-02	<6.796E-02	<6.485E-02	**1.178E-01**
plus or minus 2 SD					**6.176E-02**
MDA					**5.425E-02**
Pb-212	**8.245E-01**	**1.314E+00**	<3.294E-02	**1.999E-01**	**2.126E+00**
plus or minus 2 SD	**7.952E-02**	**1.179E-01**		**2.715E-02**	**1.834E-01**
MDA	**2.039E-02**	**2.316E-02**		**2.339E-02**	**2.782E-02**
Pb-214	**7.422E-01**	**9.231E-01**	**1.616E+00**	**7.501E-01**	**1.902E+00**
plus or minus 2 SD	**5.414E-02**	**6.431E-02**	**9.879E-02**	**7.827E-02**	**1.084E-01**
MDA	**4.169E-02**	**4.224E-02**	**6.441E-02**	**4.517E-02**	**5.249E-02**
Ra-226	**1.918E+00**	**2.052E+00**	**3.883E+00**	**1.370E+00**	**3.834E+00**
plus or minus 2 SD	**4.940E-01**	**5.357E-01**	**7.659E-01**	**4.689E-01**	**6.381E-01**
MDA	**4.147E-01**	**4.487E-01**	**6.785E-01**	**4.524E-01**	**5.554E-01**
Ac-228	**8.238E-01**	**1.240E+00**	**1.543E+00**	**9.325E-01**	**2.003E+00**
plus or minus 2 SD	**5.066E-02**	**9.594E-02**	**1.401E-01**	**9.226E-02**	**1.254E-01**
MDA	**8.066E-02**	**8.418E-02**	**1.309E-01**	**9.837E-02**	**9.308E-02**
Th-234	<2.468E-01	<2.753E-01	<3.902E-02	<3.588E-01	<3.056E-01
plus or minus 2 SD					
MDA					
Am-241	<4.138E-02	<4.391E-02	<6.619E-02	<5.191E-02	<5.777E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Gamma Data Background Samples > 50 Miles from SRS

Sample ID	OC041304SS1(B1)	B2052004	B3061704	B4120904
Date Collected	13 APR 04	20 MAY 04	17 JUN 04	09 DEC O4
Analyte Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<2.766E-01	<1.461E+01	<1.102E-01	<1.310+00
Na-22	<3.218E-02	<2.843E-02	<3.180E-02	<3.424E-02
K-40	**1.839E+01**	<5.537E-02	**7.219E-01**	**4.527E+00**
plus or minus 2sd	**1.366E+00**		**3.604E-01**	**5.751E-01**
MDA	**2.561E-01**		**2.177E-01**	**2.463E-01**
Mn-54	<2.658E-02	<4.324E-02	<4.719E-02	<3.899E-02
Co-58	<3.131E-02	<5.307E-01	<4.821E-01	<1.009E-01
Co-60	<2.953E-02	<2.080E-02	<2.320E-02	<3.049E-02
Zn-65	<7.142E-02	<1.488E-01	<1.449E-01	<1.097E-01
Y-88	<2.249E-02	<1.707E-01	<1.631E-01	<6.259E-01
Zr-95	<6.365E-02	<1.450E+00	<1.223E+00	<2.288E-01
Ru-103	<3.645E-02	>8hle	>8hle	<2.792E-01
Sb-125	<6.753E-02	<6.778E-02	<7.736E-02	<8.137E-01
I-131	<2.586E-01	>8hle	>8hle	>8hle
Cs-134	<2.565E-02	<2.985E-02	<3.332E-02	<3.393E-01
Cs-137	**3.573E-01**	**1.233E-01**	**1.697E-01**	**5.394E-02**
plus or minus 2sd	**4.634E-02**	**2.978E-02**	**3.785E-02**	**3.066E-02**
mda	**2.885E-02**	**2.110E-02**	**2.437E-02**	**2.907E-02**
Ce-144	<1.443E-01	<2.578E-01	<2.774E-01	<2.173E-01
Eu-152	<4.872E-02	<4.446E-02	<4.949E-02	<5.621E-02
Eu-154	<3.448E-02	<3.241E-02	<3.545E-02	<4.020E-02
Eu-155	**3.226E-01**	<5.812E-02	<4.845E-02	<7.803E-02
plus or minus 2sd	**6.104E-02**			
mda	**4.832E-02**			
Pb-212	**3.140E-01**	**3.100E-01**	<2.159E-02	**7.975E-02**
plus or minus 2sd	**3.902E-02**	**4.266E-02**		**5.117E-01**
mda	**2.481E-02**	**1.840E-02**		**2.606E-02**
Pb-214	**9.354E-01**	**4.353E-01**	**5.137E-01**	**9.346E-01**
plus or minus 2sd	**9.754E-02**	**4.665E-02**	**5.351E-02**	**7.082E-02**
mda	**4.583E-02**	**4.174E-02**	**4.630E-02**	**5.144E-02**
Ra-226	**2.356E+00**	<4.071E-01	**1.413E+00**	**1.633E+00**
plus or minus 2sd	**6.015E-01**		**5.585E-01**	**5.755E-01**
mda	**4.591E-01**		**4.483E-01**	**5.568E-01**
Ac-228	**1.592E+00**	<1.477E-01	**5.997E-01**	**1.068E+00**
plus or minus 2sd	**1.252E-01**		**8.710E-02**	**1.053E-01**
mda	**1.092E-01**		**1.059E-01**	**1.160E-01**
Th-234	<2.850E-01	<2.798-01	<2.578E-01	<3.018E-01
plus or minus 2sd				
mda				
Am-241	<5.899E-02	<3.581E-02	<4.263E-02	<5.372E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Gamma Data Background Samples > 50 Miles from SRS

Sample ID	B5120704	AC041504SS19(B6)	B7123004	B8093004SS
Date Collected	07 DEC 04	15 APR 04	30 DEC 04	30 SEP 04
Analyte Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<1.616E+00	<2.849E-01	<1.635E+00	<2.098E-01
Na-22	<5.069E-02	<3.637E-02	<4.742E-02	<1.678E-02
K-40	**2.790E+01**	**1.471E+01**	**2.869E+01**	**7.879E-01**
plus or minus 2sd	**1.897E+00**	**1.161E+00**	**1.912E+00**	**2.443E-01**
MDA	**2.868E-01**	**2.690E-01**	**2.462E-01**	**1.590E-01**
Mn-54	<4.905E-02	<3.032E-02	<4.515E-02	<1.982E-02
Co-58	<1.362E-01	<3.457E-02	<1.379E-01	<2.129E-02
Co-60	<4.218E-02	<3.054E-02	<3.625E-02	<1.562E-02
Zn-65	<1.512E-01	<7.760E-02	<1.388E-01	<4.175E-02
Y-88	<6.629E-02	<2.698E-02	<7.287E-02	<2.137E-02
Zr-95	<2.959E-01	<6.596E-02	<3.135E-01	<4.381E-02
Ru-103	<3.619E-01	<3.784E-02	<4.324E-01	<2.968E-02
Sb-125	<9.587E-02	<7.445E-02	<8.283E-02	<4.980E-02
I-131	>8hle	<2.243E-01	>8hle	<2.937E-01
Cs-134	<3.887E-02	<2.972E-02	<3.314E-02	<2.084E-02
Cs-137	**2.414E-01**	**9.355E-02**	**1.751E-01**	**1.638E-01**
plus or minus 2sd	**4.137E-02**	**3.277E-02**	**3.821E-02**	**3.393E-02**
mda	**3.467E-02**	**3.234E-02**	**3.392E-02**	**1.950E-02**
Ce-144	<2.423E-01	<1.572E-01	<2.141E-01	<1.039E-02
Eu-152	<6.442E-02	<5.414E-02	<5.576E-02	<3.469E-02
Eu-154	<4.635E-02	<3.867E-02	<4.008E-02	<2.478E-02
Eu-155	<6.099E-02	**3.491E-01**	<7.461E-02	<4.937E-02
plus or minus 2sd		**6.852E-02**		
mda		**6.020E-02**		
Pb-212	**1.260E+00**	**3.905E-01**	<2.544E-02	**6.643E-01**
plus or minus 2sd	**1.192E-01**	**4.746E-02**		**8.061E-02**
mda	**2.814E-02**	**2.809E-02**		**1.719E-02**
Pb-214	**8.851E-01**	**1.573E+00**	**9.762E-01**	**6.099E-01**
plus or minus 2sd	**7.217E-02**	**1.471E-01**	**7.672E-02**	**5.871E-02**
mda	**5.891E-02**	**5.092E-02**	**5.824E-02**	**3.601E-02**
Ra-226	**1.523E+00**	**2.978E+00**	**1.820E+00**	**1.111E+00**
plus or minus 2sd	**5.052E-01**	**6.414E-01**	**5.151E-01**	**3.227E-01**
mda	**5.997E-01**	**5.221E-01**	**5.120E-01**	**3.443E-01**
Ac-228	**1.072E+00**	**1.497E+00**	**1.071E+00**	**5.784E-01**
plus or minus 2sd	**1.203E-01**	**1.191E-01**	**1.021E-01**	**6.262E-02**
mda	**1.394E-01**	**1.109E-01**	**1.326E-01**	**6.209E-02**
Th-234	<3.476E-01	<3.554E-01	<3.044E-01	**4.939E-01**
plus or minus 2sd				**1.749E-01**
mda				**1.927E-01**
Am-241	<5.974E-02	<6.694E-02	<5.239E-02	<3.843E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Gamma Data Background Samples > 50 Miles from SRS

Sample ID	B9061704	B10092804	B11092804	B12061704
Date Collected	17 JUN 05	28 SEP 04	28 SEP 04	17 JUN 04
Analyte Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<1.549E-01	<1.731E-01	<1.897E-01	<1.243E+00
Na-22	<4.669E-02	<2.055E-02	<1.605E-02	<3.639E-02
K-40	**6.300E+00**	**7.891E+00**	**5.966E-01**	**8.250E-01**
plus or minus 2sd	**7.215E-01**	**6.350E-01**	**2.748E-01**	**3.718E-01**
MDA	**2.863E-01**	**1.421E-01**	**1.496E-01**	**1.955E-01**
Mn-54	<7.054E-02	<1.833E-02	<1.624E-02	<5.121E-02
Co-58	<6.373E-01	<1.997E-02	<2.098E-02	<5.579E-01
Co-60	<4.160E-02	<1.943E-02	<1.668E-02	<3.032E-02
Zn-65	<2.198E-01	<4.265E-02	<3.398E-02	<1.647E-01
Y-88	<2.105E-01	<1.967E-02	<2.084E-02	<1.733E-01
Zr-95	<1.697E+00	<3.816E-02	<4.110E-02	<1.500E+00
Ru-103	>8hle	<2.643E-02	<2.433E-02	>8hle
Sb-125	<1.084E-01	<4.418E-02	<4.025E-02	<8.450E-02
I-131	>8hle	<2.730E-01	<2.881E-01	>8hle
Cs-134	<5.097E-02	<1.661E-02	<1.619E-02	<3.463E-02
Cs-137	**2.634E-01**	**5.917E-02**	**4.863E-02**	**1.528E-01**
plus or minus 2sd	**4.588E-02**	**2.262E-02**	**2.288E-02**	**3.275E-02**
mda	**3.806E-02**	**1.752E-02**	**1.774E-02**	**2.754E-02**
Ce-144	<3.819E-01	<8.233E-02	<8.154E-02	<3.156E-01
Eu-152	<6.736E-02	<2.709E-02	<2.783E-02	<5.257E-02
Eu-154	<4.863E-02	<1.899E-02	<1.969E-02	<3.824E-02
Eu-155	**3.766E-01**	<3.644E-02	<3.640E-02	<7.252E-02
plus or minus 2sd	**6.698E-02**			
mda	**7.466E-02**			
Pb-212	**1.140E+00**	**2.157E-01**	<2.099E-02	<2.343E-02
plus or minus 2sd	**6.057E-01**	**3.409E-02**		
mda	**3.009E-02**	**1.341E-02**		
Pb-214	**1.309E+00**	**2.245E-01**	**1.512E-01**	**5.347E-01**
plus or minus 2sd	**9.375E-02**	**3.581E-02**	**3.265E-02**	**5.531E-02**
mda	**6.262E-02**	**2.972E-02**	**3.025E-02**	**5.111E-02**
Ra-226	**2.623E+00**	<2.665E-01	<2.760E-01	**1.166E+00**
plus or minus 2sd	**6.818E-01**			**5.363E-01**
mda	**6.325E-01**			**4.904E-01**
Ac-228	**1.402E+00**	<9.690E-02	<8.515E-02	**5.383E-01**
plus or minus 2sd	**1.386E-01**			**1.102E-01**
mda	**1.214E-01**			**1.135E-01**
Th-234	<3.967E-01	<2.113E-01	<2.011E-01	<2.673E-01
plus or minus 2sd				
mda				
Am-241	<6.208E-02	<2.956E-02	<2.937E-02	<4.599E-02

Notes:
1. >8hle is more than 8 half lives have elapsed
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E1052004SS1	E2B050704SS1	E3X050704SS1	E4061004SS1
ASD Sample Date	5/2/2004	5/7/2004	5/7/2004	6/10/2004
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**2200**	**14000**	**5500**	**1,600**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**7.3**	**53**	**110**	**8.1**
Beryllium	<0.3	**0.82**	**0.56**	<0.3
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Calcium	**52**	**1700**	**380**	**13**
Chromium	<1.0	**21**	**3.4**	**1.6**
Cobalt	<2.0	**4.2**	<2.0	<2.0
Copper	<1.0	**1.4**	<1.0	<1.0
Iron	**400**	**4300**	**1800**	**110**
Lead	**5.3**	**15**	**6.1**	<5
Magnesium	**67**	**220**	**190**	**29**
Manganese	**15**	**130**	**480**	**4.1**
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	<2.0	**4.7**	**3.6**	<2.0
Potassium	<100	**140**	**100**	<100
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Sodium	<10	**19**	<10	<10
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**58**	**100**	**68**	**110**
Vanadium	<2.0	**11**	**4.5**	**2.4**
Zinc	**6**	**14**	**10**	**1.1**
Mercury	<0.25	<0.25	<0.25	<0.25

Notes:
1. mg/kg = milligrams of analyte per kilogram of soil (ppm)
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E5050704SS1	E6061604SS1	E7X061604SS1	E8122004
ASD Sample Date	5/7/2004	6/16/2004	6/16/2004	20 DEC 04
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**2800**	**2500**	**11000**	**3200**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**8.4**	<5	**61**	50
Beryllium	<0.3	<0.3	**0.32**	**.31**
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Calcium	**15**	<5	**1300**	**230**
Chromium	**1.5**	**4.8**	**9.8**	**3.7**
Cobalt	<2.0	<2.0	**6.6**	<2.0
Copper	<1.0	<1.0	4	1.4
Iron	**440**	**3700**	**9800**	**3000**
Lead	**7.8**	<5	**10**	**6.2**
Magnesium	**82**	**15**	**1100**	**120**
Manganese	**5**	**2.3**	**520**	52
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	<2.0	<2.0	**4.3**	**3.3**
Potassium	<100	<100	**340**	**110**
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Sodium	<10	<10	28	<10
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**74**	**45**	**240**	**69**
Vanadium	**2.5**	**20**	**29**	**3**
Zinc	**5.9**	<1.0	**17**	**8.4**
Mercury	<0.25	<0.25	<0.25	<0.10

Notes:
1. mg/kg = milligrams of analyte per kilogram of soil (ppm)
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Perimeter Samples < 50 Miles from SRS

Sample Location:	E9061604SS1	E10122004	E11122004	E12092404HA	AKN-254
ASD Sample Date	6/16/2004	20 DEC 04	20 DEC 04	24 SEP 04	28 OCT 04
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**3100**	**5200**	**29000**	**14000**	**7900**
Antimony	<5.0	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10	<10
Barium	**18**	**18**	**77**	**170**	**41**
Beryllium	<0.3	<0.3	**.88**	**1.1**	<0.3
Boron	<10	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0	<1.0
Calcium	**140**	**64**	**63**	**820**	**34**
Chromium	**3.4**	**4.4**	**34**	**9.3**	**9.1**
Cobalt	<2.0	<2.0	**2.7**	**13**	<2.0
Copper	<1.0	1.1	**6.2**	**31**	**2.8**
Iron	**2600**	**2300**	**20000**	**12000**	**5500**
Lead	<5	**11**	**43**	**22**	**12**
Magnesium	**170**	**140**	**580**	**5000**	**140**
Manganese	**32**	**60**	**18**	**640**	**9.9**
Molybdenum	<2.0	<2.0	**3.2**	<2.0	<2.0
Nickel	<2.0	<2.0	**8.3**	**6.6**	**2.6**
Potassium	**150**	<100	**350**	**4200**	**140**
Selenium	<10	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0	<3.0
Sodium	<10	<10	**24**	**30**	<10
Thallium	<50	<50	<50	<50	<50
Tin	<50	<50	<50	<50	<50
Titanium	**89**	**160**	**180**	**1600**	**180**
Vanadium	**7.5**	**5.1**	**38**	**30**	**12**
Zinc	**5.8**	**6.5**	**20**	**42**	**7.0**
Mercury	<0.25	<0.10	<0.10	<0.10	<0.10

Notes:
1. mg/kg = milligrams of analyte per kilogram of soil (ppm)
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Background Samples > 50 Miles from SRS

Sample Location:	B1XOC041304	B2X052004FWV	B3061704SS1	B4120904
ASD Sample Date	13 APR 05	5/20/2004	6/17/2004	09 DEC 04
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**26000**	**1,000**	**10,000**	**5700**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**65**	<5.0	**34**	8.9
Beryllium	**.61**	<0.3	<0.3	<.3
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Calcium	**290**	**140**	**690**	**290**
Chromium	**8.1**	<1.0.0	**7.9**	**6.1**
Cobalt	**7.5**	<2.0.0	<2.0	<2.0
Copper	**4.7**	<1.0.0	**1.8**	<1.0.0
Iron	**20000**	<2.0	**5700**	**1800**
Lead	**40**	**7.9**	**13**	**12**
Magnesium	**2200**	**40**	**240**	**190**
Manganese	**170**	**8.2**	**66**	**30**
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	**3.7**	<2.0	**3.2**	<2.0
Potassium	**2000**	<1.000	**180**	**140**
Selenium	<1.00	<1.00	<1.00	<1.00
Silver	<3.0	<3.0	<3.0	<3.0
Sodium	**29**	<1.00	**20**	**140**
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**2000**	**100**	**160**	**260**
Vanadium	**18**	<2.0	**18**	**7.8**
Zinc	**50**	**2**	**9.8**	**2.6**
Mercury	<0.10	<0.25	<0.25	<0.10

Notes:
1. mg/kg = milligrams of analyte per kilogram of soil
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Background Samples > 50 Miles from SRS

Sample Location:	B5120704	AC041504SS1(B6)	B7123004	B8093004SS
ASD Sample Date	07 DEC 04	15 APR 04	30 DEC 04	30 SEP 04
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**35000**	**23000**	**25000**	**7400**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**180**	**220**	**59**	**20**
Beryllium	**1.0**	**.94**	**.80**	<.3
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Calcium	**1600**	**240**	**280**	**120**
Chromium	**34**	**44**	**9.4**	**18**
Cobalt	**16**	**21**	**6.2**	<2.0
Copper	**23**	**9.0**	**3.3**	2.3
Iron	**29000**	**17000**	**11000**	**5100**
Lead	**42**	**38**	**36**	**36**
Magnesium	**5700**	**1100**	**1100**	**160**
Manganese	**560**	**1500**	**360**	**31**
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	**20**	**12**	**7.6**	**3.0**
Potassium	**4000**	**830**	**810**	**110**
Selenium	<1.00	<1.00	<1.00	<1.00
Silver	<3.0	<3.0	<3.0	<3.0
Sodium	**68**	**20**	**21**	<1.00
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**1900**	**800**	**620**	**78**
Vanadium	**58**	**41**	**11**	**13**
Zinc	**52**	**36**	**31**	**8.6**
Mercury	<0.10	<0.10	<0.10	<0.10

Notes:
1. mg/kg = milligrams of analyte per kilogram of soil
2. Detects in bold

Radiological Surveillance of Soils
Metals Data Background Samples > 50 Miles from SRS

Sample Location:	B9 061704SS1	B10092804SS	B11092804SS	B12061704SS1
ASD Sample Date	6/7/2004	28 SEP 04	29 SEP 04	17 JUN 04
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**19,620**	**4900**	**420**	**2900**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**55**	**23**	**6.8**	**8.5**
Beryllium	**0.34**	**.59**	<.3	<.3
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Calcium	**630**	**45**	**420**	**200**
Chromium	**12**	**1.2**	<1.0.0	**2.8**
Cobalt	**2**	<2.0	<2.0	<2.0
Copper	**1.9**	**1.4**	<1.0.0	<1.0.0
Iron	**9000**	**2500**	**440**	**2000**
Lead	**13**	**5.8**	**6.1**	**9.6**
Magnesium	**370**	**180**	**38**	**76**
Manganese	**14**	**200**	**3.9**	**42**
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	**4.6**	**2.6**	<2.0	<2.0
Potassium	**260**	<1.000	<1.000	110
Selenium	<1.00	<1.00	<1.00	<1.00
Silver	<3.0	<3.0	<3.0	<3.0
Sodium	**31**	<1.00	**23**	<1.00
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**150**	**68**	**81**	**170**
Vanadium	**28**	**2.9**	<2.0	**4.3**
Zinc	**8.9**	**7.7**	<1.0	**4.5**
Mercury	<0.25	<0.10	<0.10	<0.10

Notes:

1. mg/kg = milligrams of analyte per kilogram of soil
2. Detects in bold

3.1.4 Summary Statistics
Radiological Surveillance Of Surface Soils
Gamma Summary Statistics

Summary statistics (Detects only)
2004 ESOP Random and Non-random Radiological Soil Data
Perimeter Samples <50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	4.33	5.82	2.16	1.02	16.06
Cs-137	0.16	0.12	0.10	0.01	0.42
Eu-155	0.25	0.12	0.28	0.12	0.35
Pb-212	0.81	0.69	0.50	0.06	2.13
Pb-214	0.94	0.55	0.75	0.32	1.90
Ra-226	1.93	1.09	1.59	0.70	3.88
Ac-228	1.15	0.50	1.02	0.40	2.00

Summary statistics (Detects only)
2004 ESOP Random and Non-random Radiological Soil Data
Background Samples > 50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	10.12	10.74	6.30	0.60	28.69
Cs-137	0.16	0.09	0.16	0.05	0.36
Eu-155	0.35	0.03	0.35	0.32	0.38
Pb-212	0.55	0.44	0.35	0.08	1.26
Pb-214	0.76	0.42	0.75	0.15	1.57
Ra-226	1.85	0.66	1.63	1.11	2.98
Ac-228	1.05	0.40	1.07	0.54	1.59

Summary statistics (Detects only)
2004 ESOP Random Radiological Soil Data
Perimeter Samples <50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	5.00	6.25	2.95	1.31	16.06
Cs-137	0.14	0.10	0.09	0.01	0.33
Eu-155	0.32	0.05	0.32	0.28	0.35
Pb-212	0.68	0.56	0.44	0.06	1.80
Pb-214	0.86	0.49	0.75	0.32	1.88
Ra-226	1.77	0.97	1.51	0.70	3.88
Ac-228	1.06	0.43	1.00	0.40	1.70
U-234 (1)	1.99	2.43	1.68	0.13	3.40
U-235	ND				
U-238	0.38	0.19	0.35	0.18	0.79

Summary statistics (Detects only)
2004 ESOP Random Radiological Soil Data
Background Samples > 50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	10.12	10.74	6.30	0.60	28.69
Cs-137	0.16	0.09	0.16	0.05	0.36
Eu-155	0.35	0.03	0.35	0.32	0.38
Pb-212	0.55	0.44	0.35	0.08	1.26
Pb-214	0.76	0.42	0.75	0.15	1.57
Ra-226	1.85	0.66	1.63	1.11	2.98
Ac-228	1.05	0.40	1.07	0.54	1.59
U-234 (1)	0.60	0.48	0.36	0.32	1.01
U-235	0.02	0.02	0.00	0.02	0.02
U-238	0.33	0.32	0.10	0.23	0.44

1. Only six random sampling locations were analyzed for Uranium
(Three perimeter and three background)
2. "ND" is "No detect"

Radiological Surveillance Of Surface Soils Metals Summary Statistics

2004 ESOP Random and Non-random Sampling
Metals Soil Data
Perimeter Samples < 50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Al:	7846.15	7717.58	5200.00	1600.00	29000.00
Ba:	51.82	48.86	45.50	7.30	170.00
Be:	0.67	0.32	0.69	0.31	1.10
Ca:	400.92	568.32	102.00	13.00	1700.00
Cr:	8.83	9.58	4.60	1.50	34.00
Co:	6.63	4.54	5.40	2.70	13.00
Cu:	6.84	10.81	2.80	1.10	31.00
Fe:	5073.08	5719.53	3000.00	110.00	20000.00
Pb:	13.84	11.41	10.50	5.30	43.00
Mg:	604.08	1353.45	140.00	15.00	5000.00
Mn:	151.41	230.45	32.00	2.30	640.00
Mo:	3.2 (1)	NA	3.2	NA	NA
Ni:	4.77	2.01	4.30	2.60	8.30
K:	691.25	1421.23	145.00	100.00	4200.00
Na:	25.25	4.86	26.00	19.00	30.00
Ti:	228.69	416.17	100.00	45.00	1600.00
V:	13.75	12.45	9.25	2.40	38.00
Zi:	11.98	10.85	7.70	1.10	42.00

2004 ESOP Random and Non-random Sampling
Metals Soil Data
Background Samples > 50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Al:	13411.67	11686.50	8700.00	420.00	35000.00
Ba:	61.84	71.94	34.00	6.80	220.00
Be:	0.86	0.51	0.71	0.34	1.80
Ca:	412.08	421.24	285.00	45.00	1600.00
Cr:	14.35	14.00	8.75	1.20	44.00
Co:	10.54	7.75	7.50	2.00	21.00
Cu:	5.38	7.05	2.30	1.00	23.00
Fe:	9412.73	9108.18	5700.00	440.00	29000.00
Pb:	20.20	14.38	13.00	5.80	42.00
Mg:	949.50	1630.08	215.00	38.00	5700.00
Mn:	248.76	429.35	54.00	3.90	1500.00
Mo:	ND (2)	ND	ND	ND	ND
Ni:	7.09	6.10	4.15	2.60	20.00
K:	937.78	1302.59	260.00	110.00	4000.00
Na:	44.00	41.93	26.00	20.00	140.00
Ti:	532.25	701.09	165.00	68.00	2000.00
V:	20.20	17.56	15.50	2.90	58.00
Zi:	19.37	19.16	8.90	2.00	52.00

2004 ESOP Random Sampling Metals Soil Data
Perimeter Samples <50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Al:	7841.67	8060.73	4200.00	1600.00	29000.00
Ba:	52.80	51.12	50.00	7.30	170.00
Be:	0.67	0.32	0.69	0.31	1.10
Ca:	434.27	583.60	140.00	13.00	1700.00
Cr:	8.81	10.05	4.40	1.50	34.00
Co:	6.63	4.54	5.40	2.70	13.00
Cu:	7.52	11.68	2.70	1.10	31.00
Fe:	5037.50	5972.35	2800.00	110.00	20000.00
Pb:	14.04	12.08	10.00	5.30	43.00
Mg:	642.75	1406.11	155.00	15.00	5000.00
Mn:	163.20	236.57	42.00	2.30	640.00
Mo:	3.2	NA	3.2	NA	NA
Ni:	5.13	1.94	4.50	3.30	8.30
K:	770.00	1516.14	150.00	100.00	4200.00
Na:	25.25	4.86	26.00	19.00	30.00
Ti:	232.75	434.41	94.50	45.00	1600.00
V:	13.91	13.04	7.50	2.40	38.00
Zi:	12.43	11.26	8.40	1.10	42.00

2004 ESOP Random Sampling Metals Soil Data
Background Samples >50 Miles

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Al:	13411.67	11686.50	8700.00	420.00	35000.00
Ba:	61.84	71.94	34.00	6.80	220.00
Be:	0.86	0.51	0.71	0.34	1.80
Ca:	412.08	421.24	285.00	45.00	1600.00
Cr:	14.35	14.00	8.75	1.20	44.00
Co:	10.54	7.75	7.50	2.00	21.00
Cu:	5.38	7.05	2.30	1.00	23.00
Fe:	9412.73	9108.18	5700.00	440.00	29000.00
Pb:	20.20	14.38	13.00	5.80	42.00
Mg:	949.50	1630.08	215.00	38.00	5700.00
Mn:	248.76	429.35	54.00	3.90	1500.00
Mo:	ND	ND	ND	ND	ND
Ni:	7.09	6.10	4.15	2.60	20.00
K:	937.78	1302.59	260.00	110.00	4000.00
Na:	44.00	41.93	26.00	20.00	140.00
Ti:	532.25	701.09	165.00	68.00	2000.00
V:	20.20	17.56	15.50	2.90	58.00
Zi:	19.37	19.16	8.90	2.00	52.00

1. Only one detect for Molybenum (Mo)
2. ND= No Detects

3.2 Radiological Monitoring of Terrestrial Vegetation On and Adjacent to SRS

3.2.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) monitors for the presence of radionuclides in vegetation around the Savannah River Site (SRS) stemming from SRS operations. In 2004, ESOP conducted independent vegetation monitoring at 16 locations around the perimeter of the SRS; three former SRS monitoring locations 25 miles from the center of SRS; and twenty-seven locations selected at random (Map 8, section 3.2.2). Sampling was performed quarterly in February, May, August, and November. Additional random and nonrandom sampling of fungi was performed to monitor the bioconcentration of select radioisotopes in the environment.

Samples from all vegetation stations were analyzed for tritium activity. Vegetation was collected for gamma analysis at selected perimeter stations where sampling had consistently produced detectable levels of cesium-137 (Cs-137).

ESOP added fungi sampling to the vegetation project in 2004. Evidence from European studies of the Chernobyl meltdown radioactive releases indicated that fungi are the greatest bioconcentrators of many heavy metals and radionuclides. Also, a DOE-SR survey of fungi noted that Cs-137 concentration fluctuation in deer may be related to the availability of fungi. Fungi were collected at 24 random ("E and B") and six non-random locations.

RESULTS AND DISCUSSION

Results from all vegetation analyses, listed by station and date, are included in section 3.2.4. Summary statistics for vegetation are presented in section 3.2.5. Results of gamma analysis of fungi are in section 3.2.4, and the descriptive statistics are presented in section 3.2.5.

<u>Tritium in Vegetation</u>

Quarterly sampling data is presented in Table 1, section 3.2.3. Tritium was detected in vegetation from all 16 of the perimeter sites sampled in 2004. Five of the stations produced tritium levels greater than the LLD in all four sampling months. The highest tritium level in 2004, 2773 pCi/L, occurred in February on the east side of SRS at station BWL-002. A randomly selected station on SRS produced the second highest level that month. The highest level detected in May, 1445 pCi/L, came from AKN-003 on the northwest side of SRS. In August the highest activity level, 1361 pCi/L, was from station BWL-003, again on the east side of SRS. The highest activity level in November, 1946 pCi/L, was from station AKN-006 on the north side of SRS.

Tritium was detected at all three of the 25-mile radius stations, once at Langley and Allendale, and twice at the station in Springfield. Three randomly selected stations within 50 miles of SRS produced detectable tritium activity, all in the month of May, in Barnwell and Bamberg counties. One background sample, from Georgetown county, exhibited tritium activity just above the LLD.

Tritium activity was generally detected uniformly around SRS in 2004. The highest tritium activities in 2004 were from sites on the western side of the SRS, in the vicinity of D-Area and Plant Vogtle. This is similar to results from 1998 through 2003 sampling (Figure 1, section 3.2.3,) SCDHEC 1999, 2000, 2001, 2002, 2003, 2004). The Heavy Water Facility in D-Area processed residual heavy water from past reactor operations and other DOE-SR sites' activities through 1998 (WSRC 2000). Residual tritium from releases at this facility may be partly responsible for higher tritium levels in the nearby vegetation. Tritium releases from the nearby Vogtle Electric Generating Plant in Georgia may also account for elevated tritium levels in this area of the SRS.

A comparison of tritium analysis results from ESOP and DOE-SR sampling are presented in Table 2, section 3.2.3. Data comparison of associated locations from the two programs was conducted by converting SRS reported activity levels. However, differences between the two programs in sampling dates, the vegetation sampled, and analysis methods make results difficult to compare. The DOE-SR program detected tritium from one station; tritium was detected in samples from nine comparable stations by the ESOP program. Results from the two colocations were less than the detection limit for both the DOE-SR program and ESOP.

Radionuclides possibly originating from the SRS were presented on lognormal probability plots to identify possible outliers and visually compare the distributions before statistically comparing the South Carolina (SC) background and SRS 50-mile perimeter populations. The lognormal probability plots for tritium samples from randomly selected stations are presented in Figures 2 and 3, section 3.2.3. Two statistical tests were performed on the data. A Wilcoxon Rank Sum test (a=0.05) was performed on the random sample results of relevant radionuclides using the null hypothesis that for tritium the SRS environmental population was the same as the SC background population at the 0.05% significance level, or the populations are the same in distribution shape and location. Nonparametric tests are preferred even if the condition of normality was met due to the high efficiency of the combined tests for hypothesis testing especially where nondetects are a large percent of the data. The focus for comparison of the populations shifts from parameters to distribution shape and location. The tritium null hypothesis was rejected at the 0.05 significance level, indicating there was a significant difference in the tritium levels in vegetation between the two populations. However, the modified quantile test supported the null hypothesis, which indicates that a false rejection may have occurred. The lognormal (LN) graphs indicate the influence of an outlier in the SC background (Figures 2 and 3, section 3.2.3). Thus, the tritium population difference may be due to other tritium producers in the SC background and not solely due to SRS operations. Future analyses with increased sample size are required to improve the power of the hypothesis test for tritium in vegetation.

Gamma Analysis of Vegetation

Cesium-137

Cesium-137 (Cs-137) was detected at seven of the ten perimeter stations sampled in 2004 (Table 3, section 3.2.3,). Six of these stations produced Cs-137 results greater than the sample MDA in all four months sampled. AKN-003 produced the highest Cs-137 activity in February, 1.633 pCi/g. BWL-006 produced the highest activity in other three sampling months, including the highest activity of the year, 1.945 pCi/g in August.

Two randomly selected stations within 50 miles of SRS produced Cs-137 activity above the MDA, one in Bamberg county and one in Orangeburg county. Two random background samples also produced detectable Cs-137 activity, from Clarendon and Georgetown counties.

Other Radionuclides

Three naturally occurring gamma-emitting radionuclides were reported in samples but are not presented in this report: beryllium-7 (Be-7), lead-212 (Pb-212), and lead-214 (Pb-214). Be-7 was detected in vegetation from five perimeter stations and one background station. Pb-212 was detected in two background samples. Pb-214 was detected at all ten perimeter stations, nine stations within 50 miles of SRS, and nine background stations.

Results of analysis for Cs-137 followed established trends in 2004. Station AKN-005 on the north side of the SRS produced detectable activity in all sampling months. This station has also produced Cs-137 activity from all samples collected in previous sampling years (Figure 4, section 3.2.3) SCDHEC 2000, 2001, 2002, 2003). For the first time in this study, the annual average result from AKN-005 was not the highest of all stations sampled. A cluster of relatively high Cs-137 levels was centered around station ALD-001 on the southeast side of the SRS. ALD-001 produced the highest average Cs-137 activity for 2004, followed by BWL-006, also on the southeast side of SRS. Another station, southwest of A- and M-Areas, produced detectable Cs-137 in all samples. These results are consistent with the results reported from 1998-2003.

Gamma analysis results for Cs-137 comparing ESOP and DOE-SR sampling in 2004 are presented in section 3.2.3, table 4. The EMS air station on Patterson Mill Road, a colocation between the two programs, produced similar results for both programs (0.260 pCi/g, ESOP; 0.276 pCi/g, DOE-SR) as it had in most previous years. Another colocation at the Allendale Gate, reinstated by DOE-SR in 2004, produced dissimilar results (1.379 pCi/g, ESOP; 0.105 pCi/g, DOE-SR). For the other EMS stations, the closest ESOP stations were selected for comparison. For the most part, DOE-SR and ESOP data were rather similar (less than 0.5 pCi/g), except for the EMS Talatha Gate station (the New Ellenton Gate) and AKN-005, which is approximately 1.9 miles east of New Ellenton. AKN-005 has consistently produced detections of Cs-137, usually the highest of the sites around SRS, while the EMS location was less than the detection limit. Differences in analysis and sampling methods (e.g., ESOP collects leaves from trees, whereas EMS collects grass) may account for this disparity. Average Cs-137 levels at the stations in Table 5 were compared, using only detections to calculate averages. The DOE-SR average (0.191 pCi/g) was within one standard deviation (0.553) of the ESOP average (0.738 pCi/g).

Radionuclides possibly originating from the SRS were presented on lognormal probability plots to provide a visual comparison of the SC background and SRS 50-mile perimeter populations.

The lognormal probability plots for Cs-137 samples from randomly selected stations are presented as section 3.2.3, figures 5 and 6. Two statistical tests were performed on the data. A Wilcoxon Rank Sum Test was performed on the random sample results using the null hypothesis that for Cs-137 the SRS environmental population was the same as the SC background population at the 0.05% significance level. This hypothesis was not rejected, indicating that the

SRS contribution to Cs-137 levels in nearby vegetation was not statistically significant. The Modified Quantile Test also supported the null hypothesis.

Gamma in Fungi

Cesium-137 (half-life 30.17 yrs.) was detected at 13 random quadrant fungi locations. The highest detection occurred in the Harleys Mill Pond quadrant (2.86 pCi/g) of Orangeburg County.

Nine out of 24 radioisotopes surveyed were detected in random and nonrandom mixed fungi, lichens, and moss collected throughout South Carolina (SRS perimeter and the SC background). The radioisotopes found in fungi included Be-7, K-40, Cs-137, Eu-155, Pb-212, Pb-214, Ra-226, Ac-228, and Ce-144 (section 3.2.4). Only six of the surveyed radioisotopes were found in fungi in the South Carolina background quadrants (Be-7, K-40, Cs-137, Ce-144, Pb-214, and Ra-226).

Subtraction of the SC average random background concentrations left only K-40, Cs-137, Eu-155, Pb-212, Pb-214, Ra-226, and Ac-228 above the average background (section 3.2.4). Subtraction of the median background concentrations indicated the same radioisotopes. Be-7 was detected (one detection of 1.95 pCi/g, New Ellenton SE quadrant), but was less than the SC background average and median concentrations.

Only 2 nonrandom sample radioisotopes (K-40 and Ce-144) were detected (section 3.2.4) above the “all background average” (random and nonrandom). The highest nonrandom radioisotope concentration in fungi for K-40 (29.31 pCi/g) was a background sample from Greenpond Road in Laurens County, and Ce-144 (1.79 pCi/g) from the Shaw Creek floodplain in Aiken County.

Random radioisotope maximum concentrations found in fungi included Be-7 (1.95 pCi/L, New Ellenton, SE E3 quadrant), K-40 (12.22 pCi/g, Harleys Mill Pond E8 quadrant, Pb-212 (0.83 pCi/g, Monetta, E9 quadrant), Pb-214 (3.30 pCi/g, Foxtown, E6 quadrant), Ra-226 (10.23 pCi/g, Foxtown, E6 quadrant), Ac-228 (2.34 pCi/g, Foxtown, E6 quadrant), Eu-155 (0.71 pCi/g, Foxtown, E6 quadrant), Cs-137 (2.86 pCi/g, Harley’s Mill Pond, E8 quadrant), and Ce-144 (0.42 pCi/g, Alvin area, B9 quadrant). The Foxtown quadrant sample was notable for having several of the maximum detections (Pb-214, Ra-226, Eu-155 and Ac-228). One branch of the headwaters in this area contained the Pb-212 maximum. These locations are in floodplains downstream of saprolitic granite influence with headwaters in the Johnston to Batesburg-Leesville Piedmont and Coastal Plain areas (Colquohoun 1983).

The Foxtown mixed-fungi and moss sample was taken from a rotten log and tree roots in a floodplain on the east side of road SSR75 opposite of the South Fork Edisto River boat landing.

This was the only detection for Eu-155 and appears as an outlier in the LN probability plot (section 3.2.3, figure 7). The similarity of the SRS perimeter and SC background probability plots below the 0 axis for Eu-155 is due to the similarity of the 0.5mda values used for nondetection comparisons Figure 8, section 3.2.3.

Cerium-144 was not detected in the SRS random environmental perimeter samples, but was detected in 6 random SC background samples and in all nonrandom samples. The Ce-144 random detections occurred only in the SC backgrounds (B1, and B8 thru B12) and nonrandom SRS perimeter locations (Oakwood, Long Branch, and Steel Creek areas) that are either downstream or within close proximity of other nuclear power plants that are operating (Vogtle, Robinson, and Summer). The SRS reactors have not been in operation since a 1992 test run at one reactor.

Radionuclides possibly originating from the SRS were presented on lognormal probability plots to identify possible outliers and compare distribution shape of the SRS 50-mile perimeter and SC background radionuclide populations. This visual qualitative comparison indicated if the two populations of particular radionuclides were of a similar distribution shape. Statistical tests (Wilcoxon and modified Quantile) of the SC background and SRS 50-mile perimeter populations of Eu-155, Cs-137, and Ce-144 were conducted to test the null hypothesis that the two populations of these radionuclides were of the same distribution shape and location (EPA 2000).

Cesium-137 was detected at 13 random quadrant fungi locations. The hypothesis that the SRS perimeter random fungi Cs-137 population had the same shape and location as the SC background random Cs-137 population was not disproved by application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level. Compare Figures 9 & 10, section 3.2.3 for similarity of shape and outliers. Thus, the DOE-SR contribution to the Cs-137 concentration in fungi was not statistically different than the other factors (primarily atomic bomb test fallout) contributing to Cs-137 concentrations in the SC background. The nonrandom fungi Cs-137 results (all below MDA) were within two standard deviations of the random Cs-137 results (section 3.2.5), and the highest detection occurred within the SRS environmental perimeter of 50-miles in the Harleys Mill Pond quadrant (2.86 pCi/g) of Orangeburg County. DOE-SR did not collect fungi for analysis in 2004.

Radioisotopes found in fungi that gave a detection level above the SC background included K-40, Pb-212, Pb-214, Ra-226, Ac-228, Eu-155, Cs-137, and Ce-144. The Foxtown quadrant sample was notable for having several of the maximum detections (Pb-214, Ra-226, Eu-155, and Ac-228). These maximums were possibly due to the flood plain location downstream of saprolitic granite natural decay material and below the two main headwater branches of the South Fork of the Edisto River.

The hypothesis that the DOE-SR perimeter random fungi Eu-155 population had the same shape and location as the SC random background Eu-155 population was not disproved by application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level**.** Thus, the SRS perimeter contributions to the Cs-137 and Eu-155 concentrations in fungi were not statistically different than the SC background concentrations (due to primarily atomic bomb tests and other nuclear reactor releases).

The Ce-144 random detections occurred only in the SC backgrounds (B1, and B8 thru B12) and nonrandom SRS perimeter locations (Oakwood, Long Branch, and Steel Creek areas) that were either downstream or within close proximity of other nuclear power plants that were operational (Vogtle, Robinson, and Summer). Since the DOE-SR nuclear power plants have not been in operation within ten half-lives of Ce-144, it is more likely that the Ce-144 contamination in the environment in 2004 was due to nuclear power plants other than those at DOE-SR. Also, since Cs-137 and Eu-144 are also fission by-products, any detection of these radioisotopes cannot be assumed to be from DOE-SR alone. However, note that the short half-life of Ce-144 (284.6 days) and the lack of DOE-SR nuclear reactor operation within a ten half-life period of year 2004 means that DOE-SR contributions of Ce-144 should have decayed to near zero or undetectable concentrations. The Ce-144 random detections occurred only in the SC background quadrants (B1, B8, B9, B10, B11, B12) and in nonrandom locations that are either downstream or within close proximity of other operational nuclear power plants. Thus, it is more likely that the Ce-144 contamination in the environment in 2004 was due to nuclear power plants other than those at DOE-SR. Also, since the other nuclear power plants can also produce the fission byproducts (Cs-137 and Eu-155), any detection of these radioisotopes cannot be assumed to be from DOE-SR alone. The hypothesis that the SRS perimeter random fungi Ce-144 population had the same shape and location as the SC random background Ce-144 population was not disproved by application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level**.** Compare Figures 9 & 10, section 3.2.3 for similarity of shape and outliers. The probability value exceeded the significance level and supported the hypotheses conclusions for the Ce-144, Eu-155, and Cs-137 hypothesis tests.

Due to the occurrence of several radioisotope maximum concentrations within a single flood plain, mixed-fungi and moss sample, ESOP will collect more samples from similar flood plain locations in the future. Consumers of wild fungi should be aware that fungi are bioconcentrators of certain naturally occurring and artificially produced heavy metal radioisotopes, which can potentially affect their health.

CONCLUSIONS AND RECOMMENDATIONS

ESOP conducted independent vegetation monitoring in 2004 at 16 locations around the perimeter of the SRS, three locations 25 miles from the center of SRS, fourteen locations selected at random from within a 50-mile radius of SRS, and twelve background locations greater than 50 miles from SRS. Tritium was detected in vegetation at all of the perimeter stations, all 25-mile, three of the 50-mile stations, and one background site**.** As in previous years, activity levels were higher in vegetation collected from the western side of SRS. ESOP data confirms the DOE-SR conclusion that elevated tritium levels at the site perimeter are due to atmospheric releases from SRS, but that tritium levels decrease with increasing distance from SRS facilities.

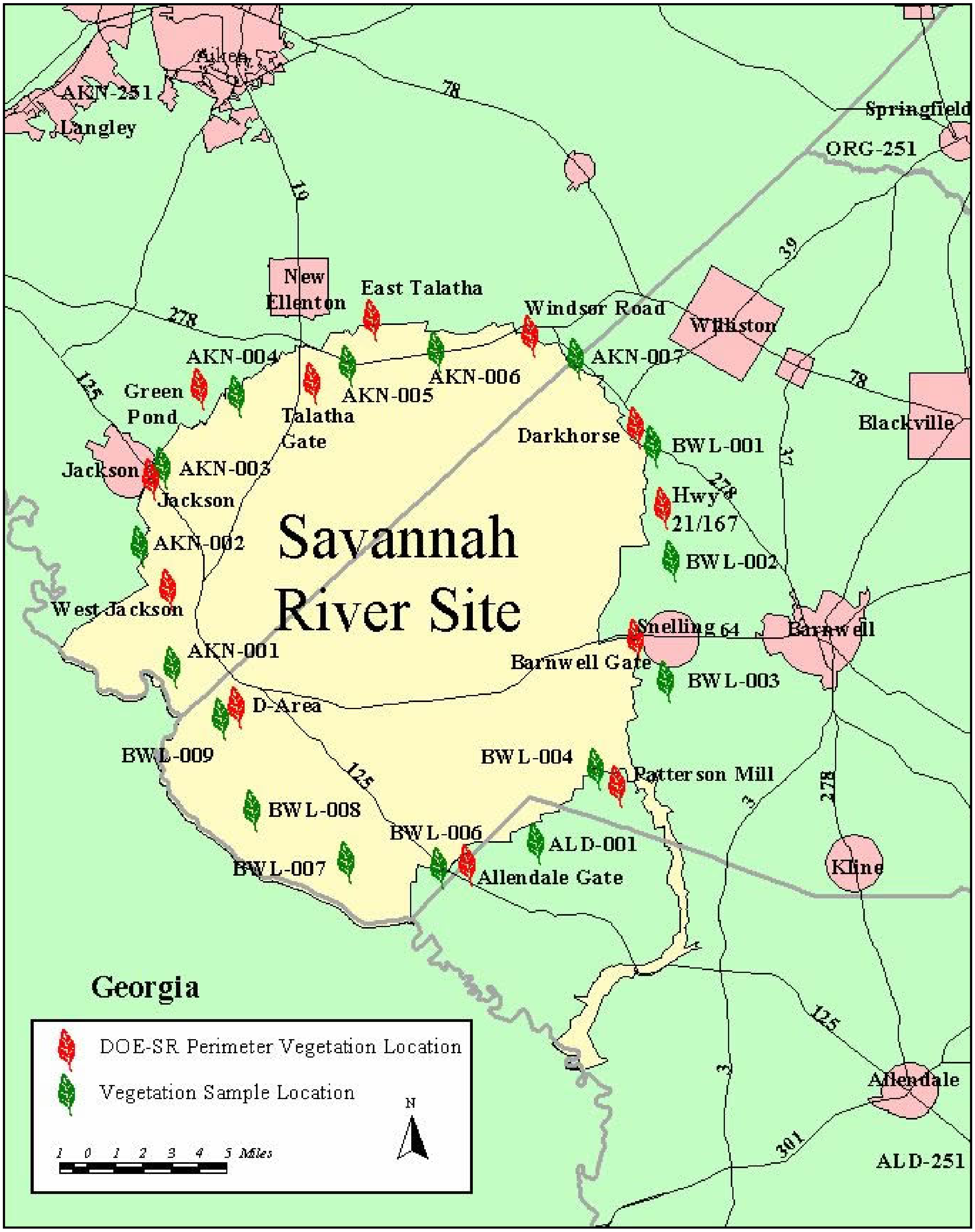
A comparison of ESOP and DOE-SR tritium data was performed on samples. The results for two co-locations were below the detection limits for both programs. The only tritium detection reported by DOE-SR came from northeast of SRS, while ESOP detected tritium at most perimeter locations. There are differences in analysis and sampling methods between the programs (e.g., ESOP collects leaves from trees, whereas EMS conducts annual grass collections), but the abundance of tritium detections by ESOP in tree leaves versus DOE-SR grass needs further investigation. DOE-SR data are reported in pCi/g without denoting whether this activity relates to a gram of water or a gram of wet vegetation. ESOP recommends that DOE-SR report tritium activity in a more relevant manner, such as picocuries per milliliter (pCi/ml) as in previous reports, to reflect the tritium activity in the water extracted from the sample.

The ESOP vegetation monitoring program was changed in 2001 to concentrate on locations where Cs-137 was detected in vegetation in previous years. Samples from nine permanent stations are analyzed for gamma-emitting radionuclides. At these locations in 2004, Cs-137 was detected at levels similar to 1998-2003. It is unclear why these sites produce higher cesium levels, as they are not located near SRS facilities, nor in areas known to be affected by past releases. ESOP and DOE-SR results from the station on Patterson Mill Road produced similar Cs-137 activity levels, while another co-location at the Allendale Gate were an order-of-magnitude different. Another large difference occurred between stations near New Ellenton. A new sampling station for gamma analysis in 2005 closer to the DOE-SR site will be used to further examine this area.

A review of critical pathways for radiation exposure around SRS indicates that vegetation is an important exposure pathway due to atmospheric releases from SRS sources. Analysis of 2002 samples was used to determine that an increase in monitoring frequency to four quarterly collections in 2003 was warranted. This schedule will be continued in 2005. Sampling will again be conducted at randomly selected sites around South Carolina to determine background and near-SRS levels for tritium and gamma-emitting radionuclides.

Most of the detected radioisotopes in fungi were naturally occurring except for Ce-144, Eu-155, and Cs-137, which may have contributions from other commercial nuclear reactors. Europium-155, Ce-144, and Cs-137 contaminant populations were statistically tested using the nonparametric Wilcoxon Rank Sum and modified Quantile tests. The hypotheses that the SRS perimeter and SC background contaminant populations of Ce-144, Eu-155, and Cs-137 were of the same shape and location were not disproved at the 0.05% significance level. Thus, the radioisotope background contributions found in fungi in 2004 that may have originated from past atomic tests or other radionuclide producing facilities (power companies) cannot be distinguished from the DOE-SR contributions within a 50-mile perimeter of a center point within the SRS. Due to the small number of detections and data set size, further random sampling and decay corrected data comparisons are needed to establish a larger sample set for improved statistical power.

3.2.2
Map 8. Terrestrial Vegetation



3.2.3 Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 1. Quarterly results of Vegetation Tritium Analysis

Station	Date	Tritium (pCi/L)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Tritium (pCi/g) [Fresh]
AKN-001	02/20/04	799	120	0.38	0.50
AKN-002	02/20/04	1105	131	0.45	0.61
AKN-003	02/20/04	308	100	0.47	0.16
AKN-004	02/20/04	214	96		
AKN-005	02/04/04	212	87	0.47	0.11
AKN-006	02/04/04	271	89	0.54	0.12
AKN-007	02/04/04	<184			
BWL-001	02/04/04	1005	117		
BWL-002	02/04/04	2773	164		
BWL-003	02/04/04	988	117	0.40	0.59
BWL-004	02/04/04	1303	129	0.49	0.66
ALD-001	02/04/04	718	116	0.50	0.36
BWL-006	02/04/04	781	114	0.49	0.40
BWL-007	02/20/04	422	105		
BWL-008	02/20/04	472	107		
BWL-009	02/20/04	1115	131		
AKN-251	02/23/04	<192			
ALD-251	02/23/04	240	103		
ORG-251	02/23/04	267	98		
LEX-505	02/23/04	<192			
HAM-506	02/23/04	<192			
SRS-502	02/23/04	1436	141		
< denotes less than reported Lower Limit of Detection					
ND denotes sampled Not Dried (no gamma analysis performed)					

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 1 (continued).

Station	Date	Tritium (pCi/L)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Tritium (pCi/g) [Fresh]
AKN-001	05/11/04	254	101	0.40	0.15
AKN-002	05/11/04	560	114	0.29	0.40
AKN-003	05/11/04	1445	144	0.38	0.90
AKN-004	05/04/04	284	91		
AKN-005	05/03/04	622	105	0.42	0.36
AKN-006	05/03/04	381	95	0.30	0.27
AKN-007	05/03/04	231	89	0.37	0.15
BWL-001	05/04/04	<188			
BWL-002	05/04/04	249	90		
BWL-003	05/04/04	274	91		
BWL-004	05/11/04	<200			
ALD-001	05/11/04	<200			
BWL-006	05/11/04	<200			
BWL-007	05/11/04	<200			
BWL-008	05/11/04	317	103		
BWL-009	05/11/04	320	104		
AKN-251	05/20/04	<188			
ALD-251	05/18/04	<188			
ORG-251	05/18/04	<188			
E1	05/18/04	<188			
E2	05/07/04	540	102	0.26	0.40
E3	05/07/04	407	96	0.32	0.28
E5	05/07/04	326	93	0.27	0.24
B2	05/18/04	<188			
B3	05/18/04	<188			
B5	05/20/04	<188			
B6	05/20/04	<188			
< denotes less than reported Lower Limit of Detection					
ND denotes sampled Not Dried (no gamma analysis performed)					

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 1 (continued).

Station	Date	Tritium (pCi/L)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Tritium (pCi/g) [Fresh]
AKN-001	08/30/04	762	120		
AKN-002	08/30/04	356	104		
AKN-003	08/30/04	<194			
AKN-004	08/17/04	1276	129		
AKN-005	08/17/04	240	93		
AKN-006	08/17/04	242	93		
AKN-007	08/17/04	<197			
BWL-001	08/17/04	226	93		
BWL-002	08/30/04	449	107		
BWL-003	08/30/04	1361	140		
BWL-004	08/30/04	1315	139		
ALD-001	08/30/04	<194			
BWL-006	08/30/04	222	97		
BWL-007	08/30/04	549	111		
BWL-008	08/30/04	541	111		
BWL-009	08/30/04	650	115		
AKN-251	08/10/04	286	95		
ALD-251	08/10/04	<197			
ORG-251	08/10/04	295	95		
E4	08/16/04	<197			
E7	08/04/04	<197			
E9	08/04/04	<197			
E12	08/16/04	<197			
B1	08/03/04	<197			
B7	08/04/04	<197			
B8	08/23/04	<185			
B12	08/23/04	<194			
< denotes less than reported Lower Limit of Detection					
ND denotes sampled Not Dried (no gamma analysis performed)					

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 1 (continued).

Station	Date	Tritium (pCi/L)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Tritium (pCi/g) [Fresh]
AKN-001	11/22/04	623	111		
AKN-002	11/22/04	487	105		
AKN-003	11/22/04	469	104		
AKN-004	11/01/04	<192			
AKN-005	11/01/04	1804	153		
AKN-006	11/01/04	1946	157		
AKN-007	11/01/04	1481	143		
BWL-001	11/01/04	266	98		
BWL-002	11/01/04	<192			
BWL-003	11/01/04	<192			
BWL-004	11/01/04	<192			
ALD-001	11/01/05	<192			
BWL-006	11/01/05	<192			
BWL-007	11/22/04	233	94		
BWL-008	11/22/04	351	99		
BWL-009	11/22/04	374	100		
AKN-251	NS				
ALD-251	NS				
ORG-251	11/10/04	<192			
E6	11/10/04	<192			
E8	11/10/04	<192			
E10	11/10/04	<192			
E11	11/10/04	<192			
B4	11/29/04	<185			
B9	11/18/04	<185			
B10	11/18/04	193	92		
B11	11/18/04	<185			
< denotes less than reported Lower Limit of Detection					
ND denotes sampled Not Dried (no gamma analysis performed)					
NS denotes Not Sampled					
Dry/Wet Ratio not available for August and November					

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 2. Comparison of Tritium Analyses, DOE-SR and ESOP Data, 2004

DOE-SR DATA		Tritium		ESOP DATA		Tritium
Station	Date	pCi/g	pCi /L[a]	Station	Date	pCi/L
D-Area	4/22/2004	<MDC		BWL-009 [b]	5/11/2004	320
West Jackson	6/2/2004	<MDC		AKN-002 [b]	5/11/2004	560
Jackson	6/2/2004	<MDC		AKN-003 [b]	5/11/2004	1445
Green Pond	4/22/2004	<MDC		AKN-004 [b]	5/4/2004	284
Talatha Gate	6/2/2004	<MDC		AKN-005 [b]	5/3/2004	622
East Talatha	6/2/2004	<MDC		AKN-006 [b]	5/3/2004	381
Windsor Road	6/2/2004	0.262	1247	AKN-007 [b]	5/3/2004	231
Darkhorse	4/22/2004	<MDC		BWL-001 [b]	5/4/2004	266
Highway 21/167	6/2/2004	<MDC		BWL-002 [b]	5/4/2004	<192
Barnwell Gate	6/2/2004	<MDC				
				BWL-003	5/4/2004	274
Patterson Mill Road [c]	4/22/2004	<MDC		BWL-004 [c]	5/11/2004	<200
				ALD-001	5/11/2004	<200
Allendale Gate [c]	6/2/2004	<MDC		BWL-006 [c]	5/11/2004	<200

<MDC denotes less than the WSRC Minimum Detectable Concentration
< - denotes less than reported Lower Limit of Detection
[a] Converted [b] Comparable ESOP location [c] Co-location

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 3. Results of Vegetation Cesium-137 Analysis

Station	Date	Cs-137 (pCi/g)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Cs-137 Wet
AKN-001	02/20/04	0.192	0.078	0.38	0.07
AKN-002	02/20/04	<0.059			
AKN-003	02/20/04	1.633	0.156	0.47	0.77
AKN-005	02/04/04	1.112	0.123	0.47	0.52
AKN-006	02/04/04	<0.056			
AKN-007	02/04/04	<0.043			
BWL-004	02/04/04	0.373	0.102	0.49	0.18
ALD-001	02/04/04	0.512	0.122	0.50	0.26
BWL-006	02/04/04	0.256	0.083	0.49	0.13
BWL-003	02/04/04	<0.046			
AKN-001	05/11/04	0.334	0.137	0.40	0.13
AKN-002	05/11/04	<0.056			
AKN-003	05/11/04	0.191	0.075	0.38	0.07
AKN-005	05/03/04	1.228	0.221	0.42	0.52
AKN-006	05/03/04	0.417	0.079	0.30	0.13
AKN-007	05/03/04	<0.050			
BWL-004	05/11/04	0.260	0.111	0.37	0.10
ALD-001	05/11/04	1.360	0.240	0.35	0.48
BWL-006	05/11/04	1.379	0.208	0.41	0.57
E1	05/18/04	<0.061			
E2	05/03/04	<0.051			
E3	05/03/04	<0.070			
E5	05/03/04	0.398	0.095	0.27	0.11
B2	05/18/04	<0.042			
B3	05/18/04	<0.061			
B5	05/20/04	<0.113			
B6	05/20/04	<0.110			

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 3 cont.

Station	Date	Cs-137 (pCi/g)	Uncertainty (+/- 2 sig)	Dry/Wet Ratio	Cs-137 Wet
AKN-001	08/30/04	0.132	0.046		
AKN-002	08/30/04	<0.039			
AKN-003	08/30/04	0.166	0.056		
AKN-005	08/17/04	1.235	0.053		
AKN-006	08/17/04	0.558	0.040		
AKN-007	08/17/04	<0.041			
BWL-004	08/30/04	0.531	0.059		
ALD-001	08/30/04	1.897	0.045		
BWL-006	08/30/04	1.945	0.047		
E4	08/16/04	<0.049			
E7	08/04/04	<0.069			
E9	08/04/04	<0.074			
E12	08/16/04	<0.081			
B1	08/03/04	<0.072			
B7	08/04/04	<0.067			
B8	08/23/04	<0.050			
B12	08/23/04	0.109	0.480		
AKN-001	11/22/04	0.200	0.057		
AKN-002	11/22/04	<0.040			
AKN-003	11/22/04	0.200	0.057		
AKN-005	11/01/04	0.807	0.051		
AKN-006	11/01/04	0.323	0.040		
AKN-007	11/01/04	<0.040			
BWL-004	11/01/04	0.317	0.040		
ALD-001	11/01/04	0.931	0.052		
BWL-006	11/01/04	0.998	0.070		
E6	11/10/04	<0.062			
E8	11/10/04	0.128	0.042		
E10	11/10/04	<0.053			
E11	11/10/04	<0.044			
B4	11/29/04	<0.040			
B9	11/18/04	<0.040			
B10	11/18/04	<0.052			
B11	11/18/04	0.104	0.040		
Dry/Wet Ratio not available for August and November					

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Table 4. Comparison of Cesium-137 Analyses, DOE-SR and ESOP Data, 2004

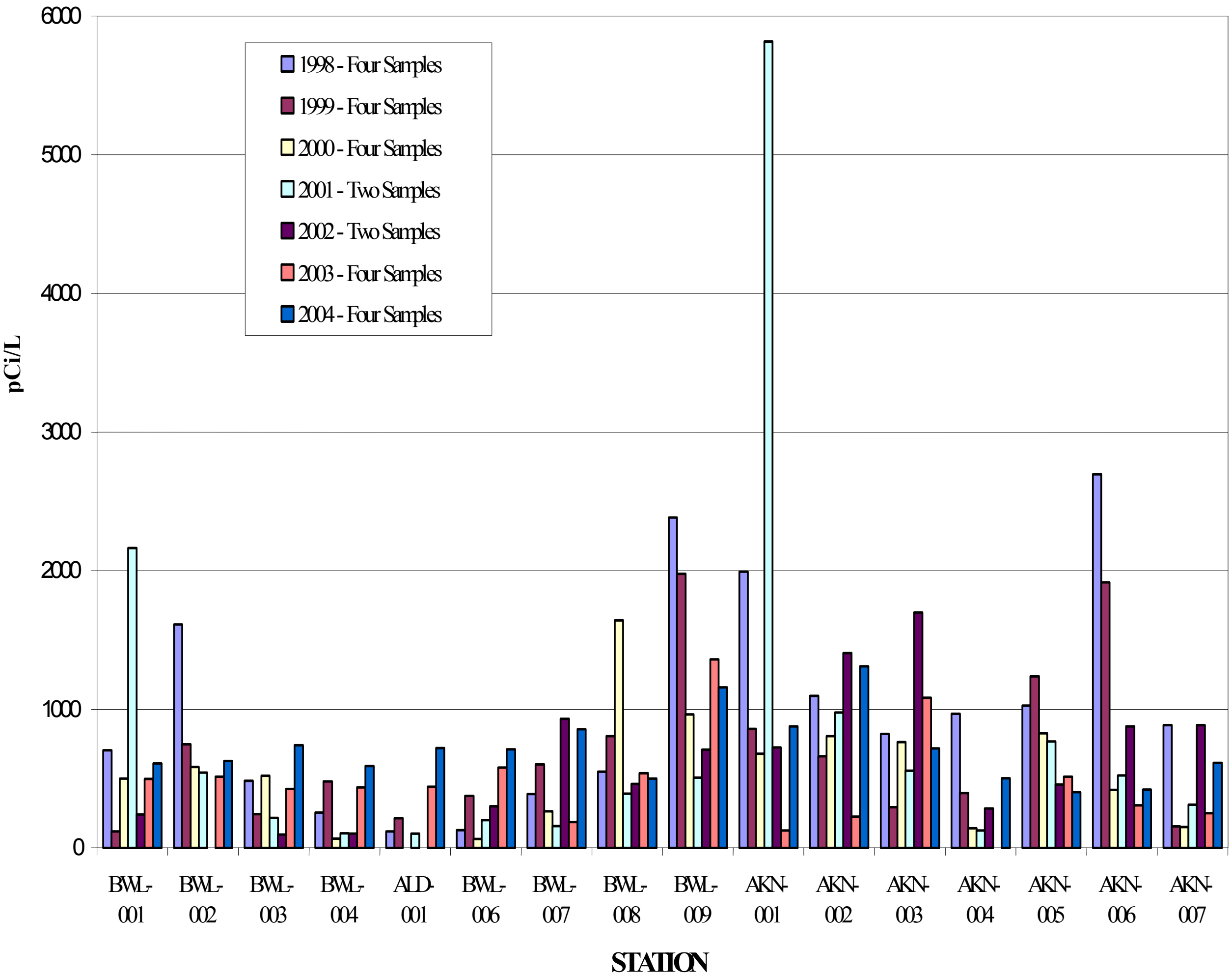
DOE-SR DATA		Cs-137		**ESOP DATA**		Cs-137	
Location	Date	pCi/g (dry)	+/- 1 sig	Station	Date	pCi/g (dry)	+/- 2 sig
D-Area	4/22/2004	<MDC		AKN-001[a]	5/11/2004	0.334	0.137
West Jackson	6/2/2004	0.115	0.036	AKN-002[a]	5/11/2004	<0.056	
Jackson	6/2/2004	<MDC		AKN-003[a]	5/11/2004	0.191	0.075
Green Pond	4/22/2004	<MDC		AKN-003[a]	5/11/2004	0.191	0.075
Talatha Gate	6/2/2004	<MDC		AKN-005[a]	5/3/2004	1.228	0.221
East Talatha	6/2/2004	0.335	0.057	AKN-006[a]	5/3/2004	0.417	0.079
Windsor Road	6/2/2004	0.173	0.05	AKN-007[a]	5/3/2004	<0.050	
Darkhorse	4/22/2004	0.14	0.044	AKN-007[a]	5/3/2004	<0.050	
Patterson Mill Road[b]	4/22/2004	0.276	0.043	BWL-004[b]	5/11/2004	0.26	0.111
				ALD-001[a]	5/11/2004	1.36	0.24
Allendale Gate[b]	6/2/2004	0.105	0.039	BWL-006[b]	5/11/2004	1.379	0.208

[a] Closest ESOP station with gamma collections

[b] Co-location

Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 1. Average Tritium in Vegetation at SRS Perimeter Stations, 1998-2004



Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 2. Tritium in Vegetation Lognormal SRS Perimeter Probability Plot

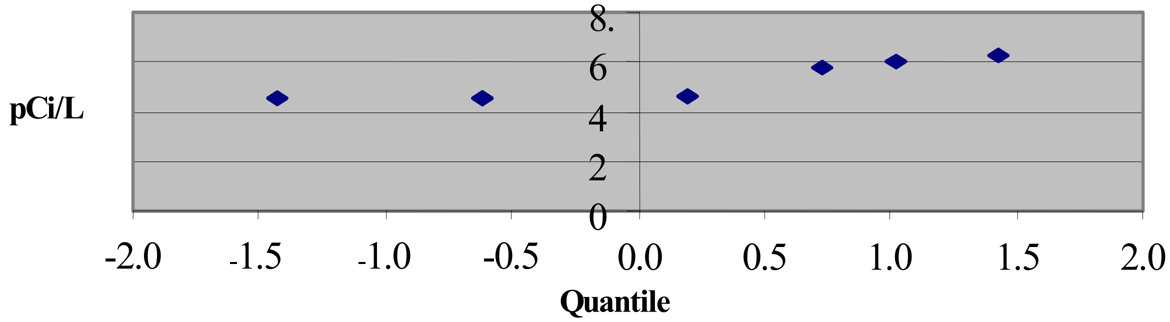
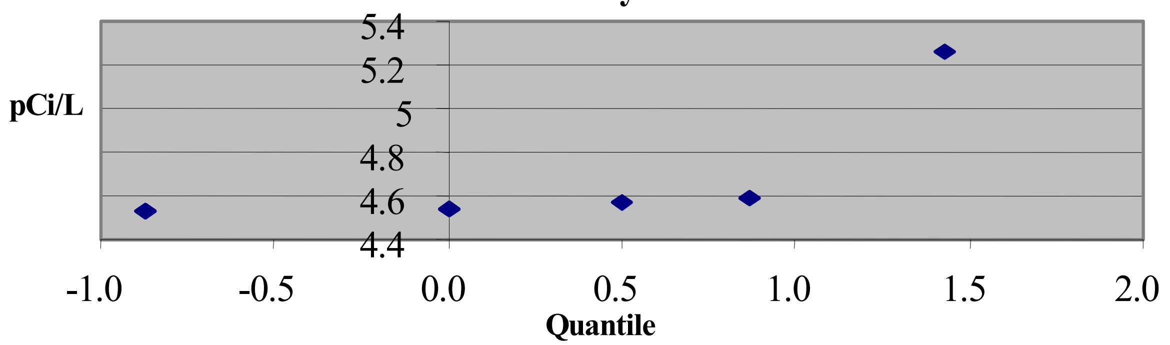
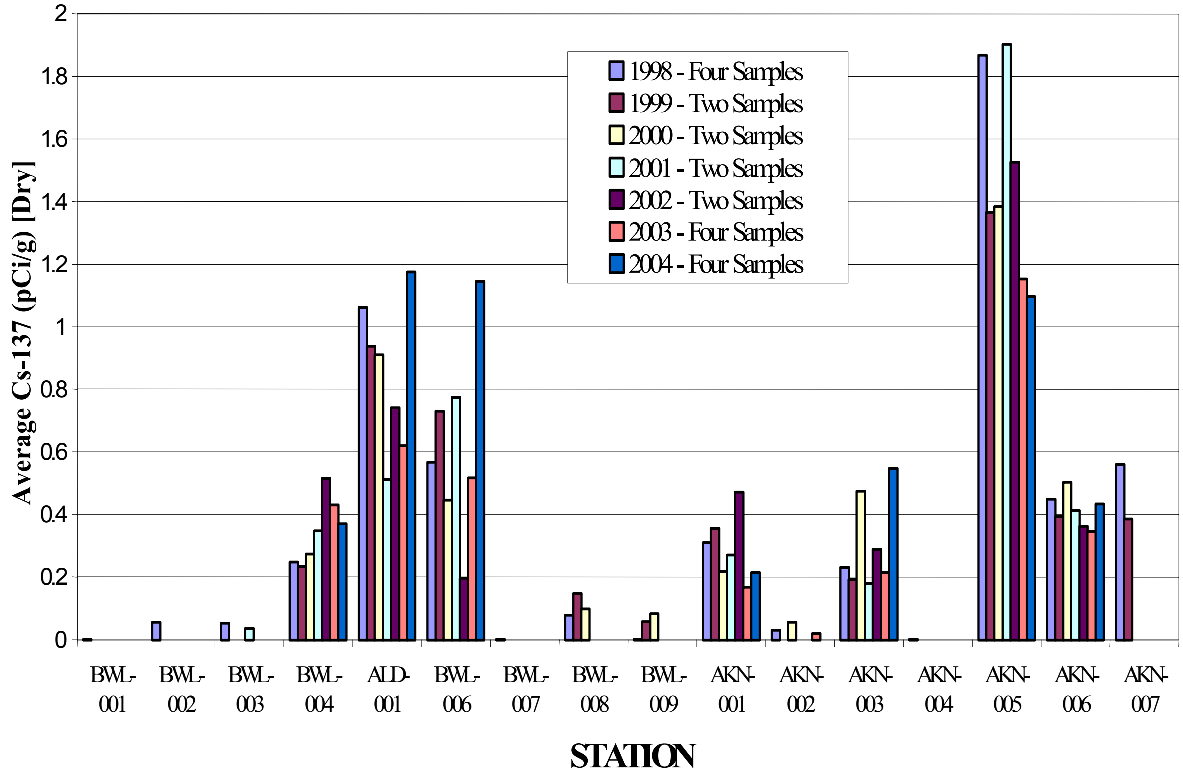


Figure 3. Tritium in Vegetation Lognormal S.C. Background Probability Plot



Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 4. Average Cesium-137 in Vegetation at SRS Perimeter Stations, 1998 - 2004



Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 5. Cs -137 in Vegetation SRS Perimeter Lognormal Probability Plot

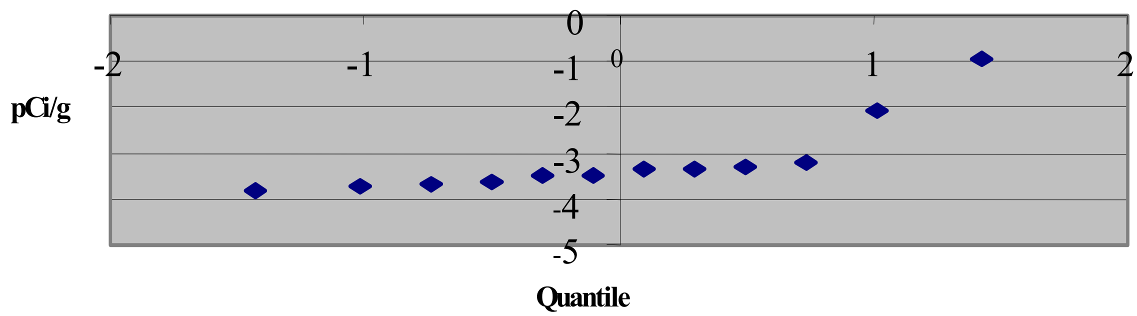
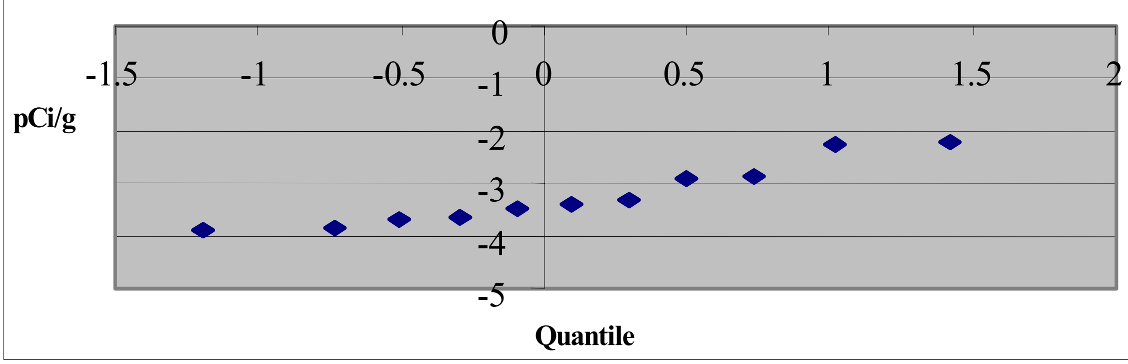


Figure 6. Cs -137 in Vegetation S.C. Background Lognormal Probability Plot



Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 7. Eu-155 in Fungi SRS Perimeter Lognormal Probability Plot

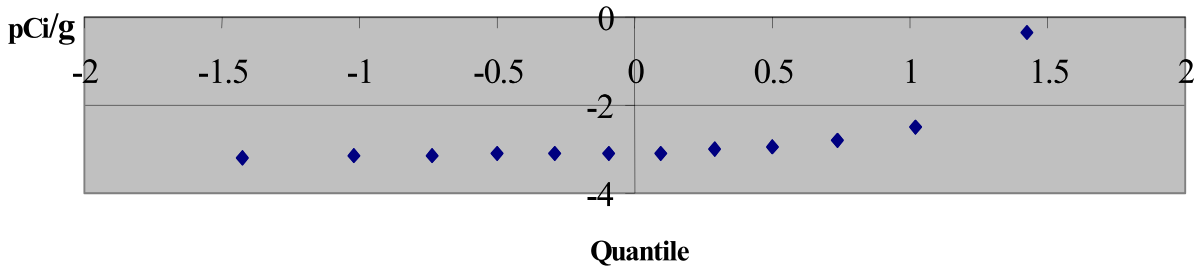
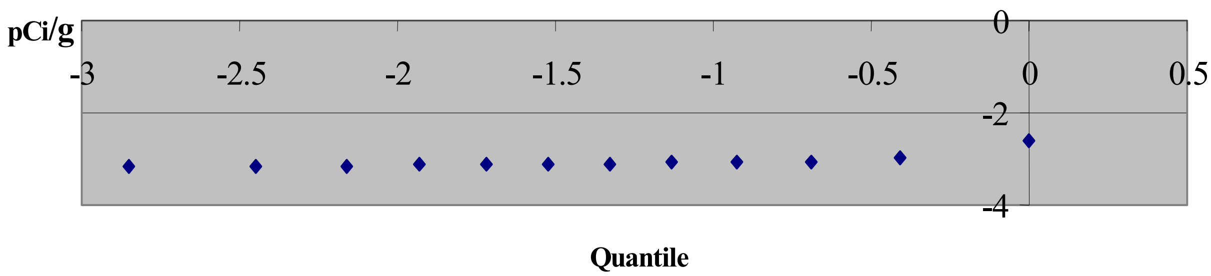


Figure 8. Eu-155 in Fungi S.C. Background Lognormal Probability Plot



Tables and Figures
Radiological Monitoring of Terrestrial Vegetation

Figure 9. Cs-137 in Fungi SRS Perimeter Lognormal Probability Plot

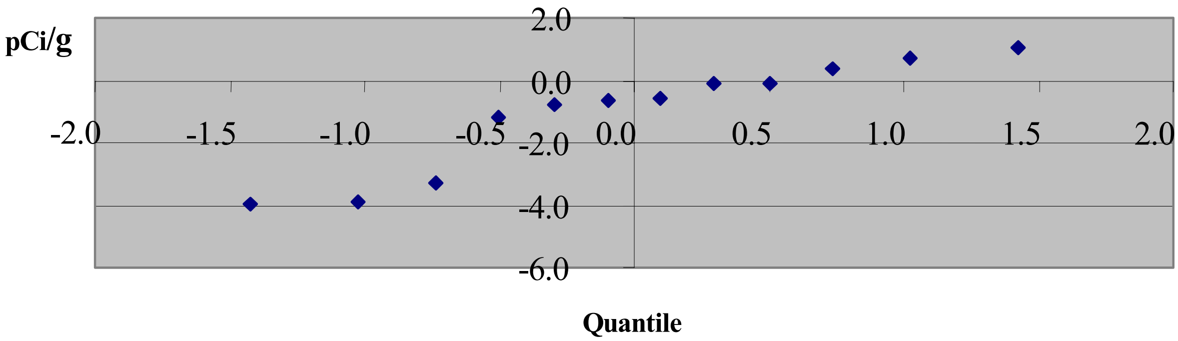
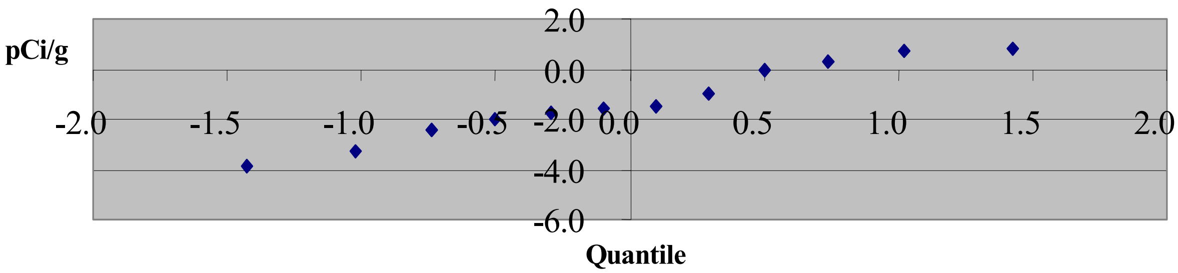


Figure 10. Cs-137 in Fungi S. C. Background Lognormal Probability Plot



3.2.4 Data
Terrestrial Vegetation Radiological Monitoring Data

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	AKN-001 - TNX Area				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	799	254	762	623
	+/- 2 sigma	120	101	120	111
	K-40 (pCi/g)	4.952	5.046	2.953	2.272
	+/- 2 sigma	1.218	1.901	0.860	1.079
	Cs-137 (pCi/g)	0.192	0.334	0.132	0.200
	+/- 2 sigma	0.078	0.137	0.055	0.052

Station:	AKN-002 - Crackerneck gate				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	1105	560	356	487
	+/- 2 sigma	131	114	104	105
	K-40 (pCi/g)	3.043	7.457	4.185	3.889
	+/- 2 sigma	1.135	1.125	0.702	0.723
	Cs-137 (pCi/g)	<0.059	<0.056	<0.039	<0.040
	+/- 2 sigma				

Station:	AKN-003 - SRS Rd. 1				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	308	1445	<194	469
	+/- 2 sigma	100	144		104
	K-40 (pCi/g)	3.437	4.107	2.620	<0.542
	+/- 2 sigma	1.109	0.968	0.888	
	Cs-137 (pCi/g)	1.633	0.191	0.162	0.200
	+/- 2 sigma	0.156	0.075	0.065	0.076

Station:	AKN-004 - SRS Rd. 1				
Sample Date:		02/20/04	05/04/04	08/17/04	11/01/04
Radionuclides	Tritium (pCi/L)	214	284	1276	<192
	+/-2 sigma	96	91	129	

Station:	AKN-005 - U.S. Hwy. 278				
Sample Date:		02/04/04	05/03/04	08/17/04	11/01/04
Radionuclides	Tritium (pCi/L)	212	622	240	1804
	+/- 2 sigma	87	105	93	153
	K-40 (pCi/g)	3.709	4.295	3.859	2.022
	+/- 2 sigma	1.259	1.877	0.851	0.949
	Cs-137 (pCi/g)	1.112	1.228	1.235	0.807
	+/- 2 sigma	0.123	0.221	0.188	0.078

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	AKN-006 - U.S. Hwy. 278				
Sample Date:		02/04/04	05/03/04	08/17/04	11/01/04
Radionuclides	Tritium (pCi/L)	271	381	242	1946
	+/- 2 sigma	89	95	93	157
	K-40 (pCi/g)	2.104	4.125	4.582	3.139
	+/- 2 sigma	0.935	0.697	0.718	0.828
	Cs-137 (pCi/g)	<0.056	0.417	0.558	0.323
	+/- 2 sigma		0.079	0.096	0.052

Station:	AKN-007 - Aiken Co. Rd. 74				
Sample Date:		02/04/04	05/03/04	08/17/04	11/01/04
Radionuclides	Tritium (pCi/L)	<184	231	<197	1481
	+/- 2 sigma		89		143
	K-40 (pCi/g)	5.605	6.268	8.032	6.178
	+/- 2 sigma	0.863	0.870	0.875	0.836
	Cs-137 (pCi/g)	<0.043	<0.050	<0.041	<0.040
	+/- 2 sigma				

Station:	BWL-001 - U.S. Hwy. 278				
Sample Date:		02/04/04	05/04/04	08/17/04	11/01/04
Radionuclides	Tritium (pCi/L)	1005	<188	226	266
	+/-2 sigma	117		93	98

Station:	BWL-002 - Barnwell Co. Rd. 21				
Sample Date:		02/04/04	05/04/04	08/30/04	11/01/04
Radionuclides	Tritium (pCi/L)	2773	249	449	<192
	+/-2 sigma	164	90	107	

Station:	BWL-003 - Barnwell Co. Rd. 54				
Sample Date:		02/04/04	05/04/04	08/30/04	11/01/04
Radionuclides	Tritium (pCi/L)	988	274	1361	<192
	+/- 2 sigma	117	91	140	
	K-40 (pCi/g)	5.776			
	+/- 2 sigma	0.945			
	Cs-137 (pCi/g)	<0.046			
	+/- 2 sigma				

Station:	BWL-004 - Air Station 614-62G				
Sample Date:		02/04/04	05/11/04	08/30/04	11/01/04
Radionuclides	Tritium (pCi/L)	1303	<200	1315	<192
	+/- 2 sigma	129		139	
	K-40 (pCi/g)	3.662	5.725	2.594	3.531
	+/- 2 sigma	1.444	1.655	0.983	0.780
	Cs-137 (pCi/g)	0.373	0.260	0.531	0.317
	+/- 2 sigma	0.102	0.111	0.106	0.048

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	BWL-006 - Allendale Gate				
Sample Date:		02/04/04	05/11/04	08/30/04	11/01/04
Radionuclides	Tritium (pCi/L)	781	<200	222	<192
	+/- 2 sigma	114		97	
	K-40 (pCi/g)	3.264	4.106	2.392	<0.620
	+/- 2 sigma	1.423	1.032	0.779	
	Cs-137 (pCi/g)	0.256	1.379	1.945	0.998
	+/- 2 sigma	0.083	0.208	0.281	0.119

Station:	BWL-007 - SRS Rd. A-17				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	422	<200	549	233
	+/-2 sigma	105		111	94

Station:	BWL-008 - SRS Rd. A-13				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	472	317	541	351
	+/-2 sigma	107	103	111	99

Station:	BWL-009 - D-Area				
Sample Date:		02/20/04	05/11/04	08/30/04	11/22/04
Radionuclides	Tritium (pCi/L)	1115	320	650	374
	+/-2 sigma	131	104	115	100

Station:	ALD-001 - Allendale Co. Rd. 12				
Sample Date:		02/04/04	05/11/04	08/30/04	11/01/04
Radionuclides	Tritium (pCi/L)	718	<200	<194	<192
	+/- 2 sigma	116			
	K-40 (pCi/g)	4.120	8.708	2.332	2.987
	+/- 2 sigma	1.575	1.827	0.749	1.015
	Cs-137 (pCi/g)	0.512	1.360	1.897	0.931
	+/- 2 sigma	0.122	0.240	0.276	0.100

Station:	AKN-251 - Langley, SC				
Sample Date:		02/23/04	05/20/04	08/10/04	NS
Radionuclides	Tritium (pCi/L)	<192	<188	286	
	+/-2 sigma			95	

Station:	ALD-251 - Allendale, SC				
Sample Date:		02/23/04	05/18/04	08/10/04	NS
Radionuclides	Tritium (pCi/L)	240	<188	<197	
	+/-2 sigma	103			

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137
5. NS denotes Not Sampled

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	ORG-251 - Springfield, SC				
Sample Date:		02/23/04	05/18/04	08/10/04	11/10/04
Radionuclides	Tritium (pCi/L)	267	<188	295	<192
	+/-2 sigma	98		95	

Station:	LEX-505 - Lexington Co., SC	
Sample Date:		02/23/04
Radionuclides	Tritium (pCi/L)	<192
	+/-2 sigma	

Station:	HAM-506 - Hampton Co., SC	
Sample Date:		02/23/04
Radionuclides	Tritium (pCi/L)	<192
	+/-2 sigma	

Station:	SRS-502 - Savannah River Site	
Sample Date:		02/23/04
Radionuclides	Tritium (pCi/L)	1436
	+/-2 sigma	141

Station:	E1 - Hampton Co., SC	
Sample Date:		05/18/04
Radionuclides	Tritium (pCi/L)	<188
	+/- 2 sigma	
	K-40 (pCi/g)	10.54
	+/- 2 sigma	1.233
	Cs-137 (pCi/g)	<0.061
	+/- 2 sigma	

Station:	E2B - Barnwell Co., SC	
Sample Date:		05/07/04
Radionuclides	Tritium (pCi/L)	540
	+/- 2 sigma	102
	K-40 (pCi/g)	5.326
	+/- 2 sigma	0.957
	Cs-137 (pCi/g)	<0.051
	+/- 2 sigma	

Station:	E3X - Barnwell Co., SC	
Sample Date:		05/07/04
Radionuclides	Tritium (pCi/L)	407
	+/- 2 sigma	96
	K-40 (pCi/g)	5.104
	+/- 2 sigma	1.111
	Cs-137 (pCi/g)	<0.070
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	E5 - Bamberg Co., SC	
Sample Date:		05/07/04
Radionuclides	Tritium (pCi/L)	326
	+/- 2 sigma	93
	K-40 (pCi/g)	7.747
	+/- 2 sigma	1.276
	Cs-137 (pCi/g)	0.398
	+/- 2 sigma	0.095

Station:	B2 - Hampton Co., SC	
Sample Date:		05/18/04
Radionuclides	Tritium (pCi/L)	<188
	+/- 2 sigma	
	K-40 (pCi/g)	4.846
	+/- 2 sigma	0.764
	Cs-137 (pCi/g)	<0.042
	+/- 2 sigma	

Station:	B3 - Orangeburg Co., SC	
Sample Date:		05/18/04
Radionuclides	Tritium (pCi/L)	<188
	+/- 2 sigma	
	K-40 (pCi/g)	7.521
	+/- 2 sigma	1.054
	Cs-137 (pCi/g)	<0.061
	+/- 2 sigma	

Station:	B5 - Union Co., SC	
Sample Date:		05/20/04
Radionuclides	Tritium (pCi/L)	<188
	+/- 2 sigma	
	K-40 (pCi/g)	7.461
	+/- 2 sigma	1.686
	Cs-137 (pCi/g)	<0.113
	+/- 2 sigma	

Station:	B6 - Abbeville Co., SC	
Sample Date:		05/20/04
Radionuclides	Tritium (pCi/L)	<188
	+/- 2 sigma	
	K-40 (pCi/g)	8.29
	+/- 2 sigma	1.984
	Cs-137 (pCi/g)	<0.110
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	E4 - Aiken Co., SC	
Sample Date:		08/16/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	6.156
	+/- 2 sigma	0.814
	Cs-137 (pCi/g)	<0.049
	+/- 2 sigma	

Station:	E7 - Saluda Co., SC	
Sample Date:		08/04/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	4.318
	+/- 2 sigma	1.114
	Cs-137 (pCi/g)	<0.069
	+/- 2 sigma	

Station:	E9 - Aiken Co., SC	
Sample Date:		08/04/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	6.152
	+/- 2 sigma	1.286
	Cs-137 (pCi/g)	<0.074
	+/- 2 sigma	

Station:	E12 - Edgefield Co., SC	
Sample Date:		08/16/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	5.018
	+/- 2 sigma	1.318
	Cs-137 (pCi/g)	<0.080
	+/- 2 sigma	

Station:	B1 - Oconee Co., SC	
Sample Date:		08/03/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	6.824
	+/- 2 sigma	1.186
	Cs-137 (pCi/g)	<0.072
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring Vegetation Analysis Results

Station:	B7 - Greenville Co., SC	
Sample Date:		08/04/04
Radionuclides	Tritium (pCi/L)	<197
	+/- 2 sigma	
	K-40 (pCi/g)	14.91
	+/- 2 sigma	1.544
	Cs-137 (pCi/g)	<0.067
	+/- 2 sigma	

Station:	B8 - Dillon Co., SC	
Sample Date:		08/23/04
Radionuclides	Tritium (pCi/L)	342
	+/- 2 sigma	103
	K-40 (pCi/g)	6.626
	+/- 2 sigma	0.884
	Cs-137 (pCi/g)	<0.050
	+/- 2 sigma	

Station:	B12 - Clarendon Co., SC	
Sample Date:		08/23/04
Radionuclides	Tritium (pCi/L)	<194
	+/- 2 sigma	
	K-40 (pCi/g)	3.562
	+/- 2 sigma	0.866
	Cs-137 (pCi/g)	0.109
	+/- 2 sigma	0.054

Station:	E6 - Aiken Co., SC	
Sample Date:		11/10/04
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	2.537
	+/- 2 sigma	1.113
	Cs-137 (pCi/g)	<0.062
	+/- 2 sigma	

Station:	E8 - Orangeburg Co., SC	
Sample Date:		11/10/04
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	1.642
	+/- 2 sigma	0.762
	Cs-137 (pCi/g)	0.128
	+/- 2 sigma	0.042

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring Vegetation Analysis Results

Station:	E10 - Orangeburg Co., SC	
Sample Date:		11/10/04
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	7.839
	+/- 2 sigma	1.125
	Cs-137 (pCi/g)	<0.053
	+/- 2 sigma	

Station:	E11 - Orangeburg Co., SC	
Sample Date:		11/10/04
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	3.724
	+/- 2 sigma	0.830
	Cs-137 (pCi/g)	<0.044
	+/- 2 sigma	

Station:	B9 - Berkeley Co., SC	
Sample Date:		11/18/04
Radionuclides	Tritium (pCi/L)	<185
	+/- 2 sigma	
	K-40 (pCi/g)	1.973
	+/- 2 sigma	0.736
	Cs-137 (pCi/g)	<0.040
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Vegetation Analysis Results

Station:	B10 - Georgetown Co., SC	
Sample Date:		11/18/04
Radionuclides	Tritium (pCi/L)	193
	+/- 2 sigma	92
	K-40 (pCi/g)	3.481
	+/- 2 sigma	0.965
	Cs-137 (pCi/g)	<0.052
	+/- 2 sigma	

Station:	B11 - Georgetown Co., SC	
Sample Date:		11/18/04
Radionuclides	Tritium (pCi/L)	<185
	+/- 2 sigma	
	K-40 (pCi/g)	<0.350
	+/- 2 sigma	
	Cs-137 (pCi/g)	0.104
	+/- 2 sigma	0.042

Station:	B4 - Charleston Co., SC	
Sample Date:		11/29/04
Radionuclides	Tritium (pCi/L)	<185
	+/- 2 sigma	
	K-40 (pCi/g)	4.369
	+/- 2 sigma	0.797
	Cs-137 (pCi/g)	<0.040
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Terrestrial Vegetation Radiological Monitoring
Fungi Analysis Results

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12
Be-7	<MDA	<MDA	**1.95**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Na-22	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	**2.23**	**4.17**	**2.63**	**1.33**	**8.43**	**4.07**	<MDA	**12.22**	**3.85**	**2.66**	**5.80**	**7.02**
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Y-88	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zr-95	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ru-103	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	>8hle	<MDA	<MDA	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	**0.46**	**1.47**	**0.92**	**0.54**	**0.89**	**0.55**	<MDA	**2.86**	<MDA	**0.30**	**2.08**	<MDA
Ce-144	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-155	<MDA	<MDA	<MDA	<MDA	<MDA	**0.71**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	**0.16**	<MDA	<MDA	**0.62**	<MDA	<MDA	**0.83**	<MDA	<MDA	<MDA
Pb-214	**0.31**	<MDA	**0.28**	**0.16**	**0.32**	**3.30**	**0.21**	<MDA	**0.59**	**0.20**	<MDA	**0.32**
Ra-226	<MDA	<MDA	<MDA	<MDA	<MDA	**10.23**	<MDA	<MDA	**1.88**	<MDA	<MDA	<MDA
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	**2.34**	<MDA	<MDA	**1.81**	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Notes:												
1. ">8hle" means no data due to greater than eight half-lives elapsing.												
2. "<MDA" means less than a minimum detectable activity.												
3. Highlighted numbers are positive detected concentrations.												
4. Check the list of radioisotopes for the abbreviation identifications.												

Terrestrial Vegetation Radiological Monitoring
Fungi Analysis Results

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Be-7	**7.67**	<MDA	<MDA	<MDA	<MDA	**1.97**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Na-22	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	**1.50**	**3.49**	**1.19**	**2.73**	**9.39**	**1.76**	<MDA	**4.79**	**7.41**	**3.59**	**3.17**	**1.62**
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Y-88	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zr-95	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ru-103	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle	>8hle
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	<MDA	**2.31**	**0.21**	**0.96**	**0.17**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ce-144	**0.07**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	**0.07**	**0.42**	**0.10**	**0.27**	**0.07**
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-155	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	<MDA	**0.27**	**0.13**	**0.30**	**0.31**	**0.26**	**0.30**	**0.31**	<MDA	**0.15**	<MDA	**0.66**
Ra-226	**0.08**	<MDA	**0.06**	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	**2.99**
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

Notes:
1. ">8hle" means no data due to greater than eight half-lives elapsing.
2. "<MDA" means less than a minimum detectable activity.
3. Highlighted numbers are positive detected concentrations.
4. Check the list of radioisotopes for the abbreviation identifications.

Terrestrial Vegetation Radiological Monitoring
Nonrandom Fungi Sample Analysis Results

	AKN-255-102804	AKN-254-102804	AKN-255-102804	TB-102004	STCK-112404	GP082204PG
Be-7	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Na-22	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
K-40	**17.19**	**17.73**	**27.32**	**27.91**	**3.73**	**29.31**
Mn-54	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-58	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Co-60	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zn-65	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Y-88	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Zr-95	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ru-103	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Sb-125	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-131			<MDA			
Cs-134	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Cs-137	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ce-144	**1.79**	**1.77**	**0.36**	**0.05**	**0.13**	**0.08**
Eu-152	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-154	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Eu-155	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-212	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pb-214	<MDA	<MDA	**0.18**	<MDA	<MDA	<MDA
Ra-226	<MDA	<MDA	<MDA	<MDA	**0.17**	**0.05**
Ac-228	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Th-234	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Notes:						
1. ">8hle" means no data due to greater than eight half-lives elapsing.						
2. "<MDA" means less than a minimum detectable activity.						
3. Highlighted numbers are positive detected concentrations.						
4. Check the list of radioisotopes for the abbreviation identifications.						

3.2.5 Summary Statistics
Terrestrial Vegetation Radiological Monitoring
Terrestrial Vegetation

Tritium Levels (pCi/L) from SRS Perimeter Stations

Station	N (ND)	Average	Std Dev	Median	Minimum	Maximum
AKN-001	4 (0)	610	249	693	623	799
AKN-002	4 (0)	627	330	524	356	1105
AKN-003	3 (1)	741	615	469	308	1445
AKN-004	3 (1)	591	594	284	214	1276
AKN-005	4 (0)	720	747	431	212	1804
AKN-006	4 (0)	710	826	326	242	1946
AKN-007	2 (2)	856	884	856	231	1481
BWL-001	3 (1)	499	439	266	226	1005
BWL-002	3 (1)	1157	1403	449	249	2773
BWL-003	3 (1)	874	552	988	274	1361
BWL-004	2 (2)	1309	8	1309	1303	1315
ALD-001	1 (3)	NA	NA	NA	718	718
BWL-006	2 (2)	502	395	502	222	781
BWL-007	3 (1)	401	159	422	233	549
BWL-008	4 (0)	420	104	412	317	541
BWL-009	4 (0)	615	363	512	320	1115

ND denotes non-detect; NA denotes Not Applicable
Averages exclude non-detects

Cesium-137 Levels (pCi/g - Dry) from SRS Perimeter Stations

Station	N (ND)	Average	Std Dev	Median	Minimum	Maximum
AKN-001	4 (0)	0.215	0.085	0.196	0.132	0.200
AKN-002	0 (4)	NA	NA	NA	NA	NA
AKN-003	4 (0)	0.547	0.725	0.196	0.162	1.633
AKN-005	4 (0)	1.096	0.200	1.170	0.807	1.235
AKN-006	3 (1)	0.433	0.118	0.417	0.323	0.558
AKN-007	0 (4)	NA	NA	NA	NA	NA
BWL-004	4 (0)	0.370	0.117	0.345	0.260	0.531
ALD-001	4 (0)	1.175	0.593	1.146	0.512	1.897
BWL-006	4 (0)	1.145	0.709	1.188	0.259	1.945

ND denotes non-detect; NA denotes Not Applicable
Averages exclude non-detects

Summary Statistics
Terrestrial Vegetation Radiological Monitoring
Terrestrial Vegetation (cont)

Tritium Levels (pCi/L) in SRS Perimeter Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum	Maximum
49 (15)	709	358	485	212	2773

ND denotes non-detect
Average excludes non-detects

Cs-137 Levels (pCi/g-Dry) in SRS Perimeter Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum	Maximum
27 (9)	0.711	0.296	0.417	0.132	1.945

ND denotes non-detect
Average excludes non-detects

Tritium Levels (pCi/L) in 25-mile Radius Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum	Maximum
4 (6)	269	24	277	240	295

ND denotes non-detect
Average excludes non-detects

Tritium Levels (pCi/L) in 50-mile Radius Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum*	Maximum
12 (9)	179	155	99	94	540

ND denotes non-detect
Average includes non-detects calculated as MDA x 0.5
* Minimum is lowest MDA x 0.5

Tritium Levels (pCi/L) in S.C. Background Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum*	Maximum
12 (11)	103	29	94	94	193

ND denotes non-detect
Average includes non-detects calculated as MDA x 0.5
* Minimum is lowest MDA x 0.5

Cs-137 Levels (pCi/g-Dry) in 50-mile Radius Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum*	Maximum
12 (10)	0.069	0.107	0.033	0.022	0.398

ND denotes non-detect
Average includes non-detects calculated as MDA x 0.5
* Minimum is lowest MDA x 0.5

Cs-137 Levels (pCi/g-Dry) in S.C. Background Vegetation Samples

N (ND)	Average	Std Dev	Median	Minimum*	Maximum
12 (10)	0.045	0.031	0.032	0.020	0.109

ND denotes non-detect
Average includes non-detects calculated as MDA x 0.5
* Minimum is lowest MDA x 0.5

Summary Statistics
Terrestrial Vegetation Radiological Monitoring
Fungi

Random Collections of Fungi Summary Statistics (12 Samples Each)

	SRS Perimeter or "E" Data Set				Background or "B" Data Set			E-B Results	
	#D*4	Average	sd	Median	Average	sd	Median	Avg	Median
Be-7	1	1.95	*3	1.95	4.82	4.03	4.82	**<Bkg**	**<Bkg**
K-40	11	4.95	3.22	4.07	3.69	2.61	3.17	**1.25**	**0.91**
Cs-137	9	1.12	0.86	0.89	0.91	1.00	0.59	**0.20**	**0.30**
Eu-155	1	0.71		0.71				**0.71**	**0.71**
Pb-212	3	0.54	0.34	0.62				**0.54**	**0.62**
Pb-214	9	0.63		0.31	0.30	0.15	0.30	**0.33**	**0.02**
Ra-226	2	6.05	5.90	6.05	1.04	1.69	0.08	**5.01**	**5.98**
Ac-228	2	2.07	0.38	2.07				**2.07**	**2.07**
Ce-144	6	ND*1	ND	ND	0.16	0.15	0.08	**<Bkg**	**<Bkg**

Notes: Refer to the appendix for radioisotope names and information.
*1 - ND = nondetection
*2 - "sd" = standard deviation
*3 - The grey boxes refer to a lack of applicable data.
*4 - "#D" = number of detections.
*5 - Data is in pCi/g.

SRS Perimeter and S. C. Background Fungi Nonrandom Samples

Nonrandom SRS Perimeter*7					NrBkg	All Bkg Samples (13)			Minus All Bkg
pCi/g (*3)	#D*1	Avg	sd	Med	1NrB*5	Avg	sd	Med	>Bkg
Be-7	0	ND*2	ND	ND	ND	ND	ND	ND	ND
K-40 (*6)	6	**18.78**	**9.83**	**17.73**	29.31	**5.83**	**7.80**	**3.33**	*12.95*
Cs-137	0	ND	ND	ND	ND	ND	ND	ND	ND
Eu-155	0	ND	ND	ND	ND	ND	ND	ND	ND
Pb-212	0	ND	ND	ND	ND	ND	ND	ND	ND
Pb-214	1	**0.18**	ND	**0.18**	ND	**0.29**	0.15	**0.28**	**<Bkg**
Ra-226	2	**0.17**	ND	**0.17**	0.05	**0.79**	**1.46**	**0.07**	**<Bkg**
Ac-228	0	ND	ND	ND	ND	ND	ND	ND	ND
Ce-144	6	**0.82**	**0.88**	**0.37**	0.08	**0.15**	**0.14**	**0.08**	*0.67*6*

Notes(*#):
*1 - "#D" means number of detections out of 6 samples (includes 1 back
*2 - "ND" and grayed areas means either not detected or less than zero.
*3 - "pCi/g" means picocuries per gram.
*4 - Highlighted data represents nonrandom"detections only" statistics.
*5 - "1NrB" means only one nonrandom background sample.
*6 - Italized data represents all background subtraction, random and nonrandom.
*7 - "Avg" = average, "sd" = standard deviation, "Med" = median

3.3 Radiological Monitoring of Edible Vegetation

3.3.1 Summary

Edible vegetation can be contaminated externally by direct deposition of airborne materials, non-point source water runoff, and precipitation that contains radioactive materials. Vegetation can also be contaminated internally by uptake of radionuclides through the root system. As a result, radioactive materials could be transported through the human body via the consumption of food products containing radioactivity.

The Department of Energy – Savannah River (DOE-SR) has historically conducted monitoring on and around the Savannah River Site (SRS) to determine activities of radionuclides in edible vegetation. The Edible Vegetation Radiological Monitoring Project is a component of the Environmental Surveillance and Oversight Program (ESOP) that monitors edible food products from perimeter locations around the SRS. ESOP serves to evaluate the DOE-SR environmental monitoring programs, conduct independent monitoring, and educate the public.

For 2004, project sampling began in early summer and continued through late fall ending with 14 total samples (Map 9, section 3.3.2). A background sample was collected in Laurens County, South Carolina. Various fruits and vegetables were collected according to the growing season and availability. Three of the total 14 samples were collected on SRS to make on-Site/off-Site data comparisons. All samples collected were analyzed for tritium and gamma-emitting radionuclides.

RESULTS AND DISCUSSION

<u>Tritium</u>

ESOP had tritium detections in nine of the total 14 samples collected (section 3.3.3). Of these nine detections, the highest tritium detection outside of the perimeter of the SRS was 0.803 pCi/g, a wild plum sample, from within 10 miles of the SRS (SNL-203). The lowest tritium detection within 10 miles of SRS was 0.189 picocuries per gram (pCi/g), a passion fruit sample, from approximately 20 miles outside of the SRS (WIL-204). For data comparison, ESOP collected samples on the SRS this year. The highest tritium detection on SRS, at the Pen Branch location (SR-203), was 1.605 pCi/g, found in wild blackberries. The lowest tritium detection on SRS, at the Beaver Dam Creek location (SR-201), was 0.424 pCi/g found in wild blackberries. DOE-SR reported no tritium detections in any of their fruit data. ESOP had no tritium detections in greens. DOE-SR reported one tritium detect in greens (0.091 pCi/g).

The tritium values ranged from 0.189 pCi/g to 0.803 pCi/g around the perimeter of the SRS. The average tritium value was 0.597 pCi/g, the standard deviation was 0.525 pCi/g, and the median value was 0.284 pCi/g. The DOE-SR of 0.091 pCi/g was within one standard deviation of the ESOP average detection of 0.507 pCi/g ± 0.525 standard deviation.

Gamma-emitting radionuclides

ESOP detected cesium-137 (Cs-137) in a fruit sample, wild blackberries, at one SRS on-site location (SR-202, Fourmile Creek) at 0.063 pCi/g, while all off-Site Cs-137 samples were less than the MDA (section 3.3.3). DOE-SR reported one detection of Cs-137 (0.051 pCi/g) for fruit (type was not reported).

No man-made gamma-emitters were detected in the ESOP greens (mustards and collards) samples for 2004 (section 3.3.3). DOE-SR reported Cs-137 detections in collards at five locations and strontium- 89/90 detections in collards at two locations for 2004.

ESOP had only one detectable value for Cs-137, 0.063 pCi/g. Since there was only one detectable value for Cs-137, 0.063 pCi/g was also the average detected value and the median, and the standard deviation could not be calculated. Of the 10 DOE-SR samples, there were only six detectable values for Cs-137. The average Cs-137 detected value was 0.300 pCi/g, the standard deviation was 0.217 pCi/g, and the median value was 0.284 pCi/g. The single ESOP detection (0.063 pCi/g) was approximately within two standard deviations of the DOE-SR average.

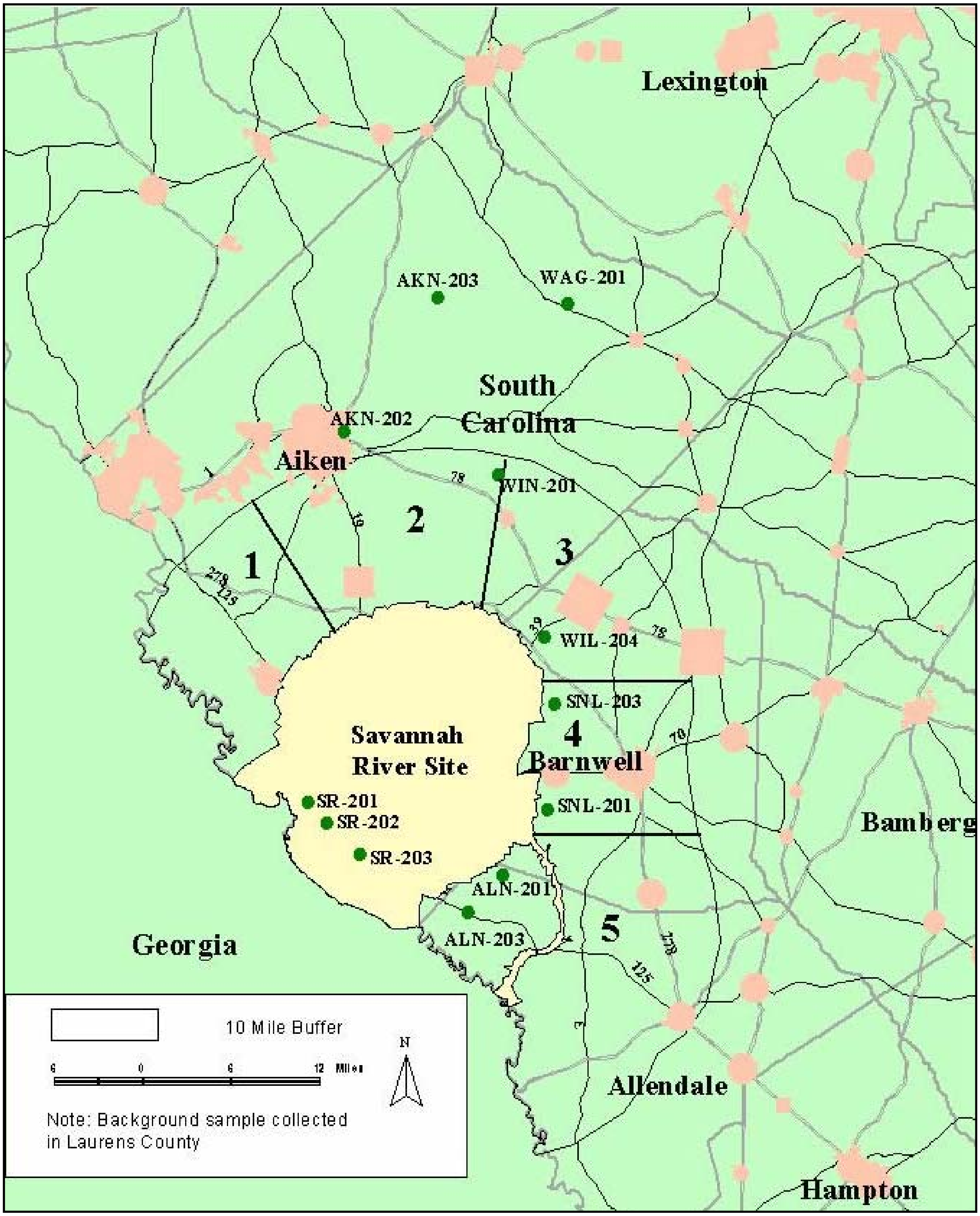
CONCLUSIONS AND RECOMMENDATIONS

As airborne tritium interacts with water in the atmosphere, it becomes available to vegetation, entering plants through root systems or from leaf surfaces in contact with moisture containing small amounts of tritium contamination. Nine of 14 ESOP edible vegetation samples collected for the season were found to have concentrations of tritium. Of the samples collected beyond the SRS perimeter, the highest tritium level detected was 0.803 pCi/g. Of those sampled on SRS the highest tritium level detected was 1.605 pCi/g. DOE-SR reported one detection of tritium off-site, (0.09 pCi/g) in greens. ESOP had a single detection of Cs-137 approximately two standard deviations of the DOE-SR average. These detections can be attributed primarily to releases from SRS operations. These results are consistent with local historically reported data (WSRC 2004).

Statistically, ESOP reported the average, standard deviation, and median values for tritium. Summary statistics are given in section 3.3.4.

For the sampling year 2005, ESOP plans to follow the new ESOP guidelines set forth for random and background sampling. Hopefully, this approach will aid in finding usable sampling sites, in implementing partnerships with other state agencies across South Carolina, and in gaining an unbiased approach to data collection. ESOP will need to send some samples to a contract lab in 2005 for strontium-89/90 and plutonium-238 data comparisons with DOE-SR. For better comparisons with DOE-SR data, DOE-SR may consider reporting what types of fruits or greens were collected at what locations in their data tables.

3.3.2
Map 9. Edible Vegetation Monitoring Project



3.3.3 Data
Edible Vegetation Monitoring Data

Edible Vegetation Radiological Monitoring

Sample Location:		ALN-201	ALN-203	SNL-201	SNL-203	SR-201	SR-202	SR-203
Sample Date:		06/03/04	06/03/04	06/03/04	06/03/04	06/03/04	06/03/04	06/03/04
Matrix		Fruit	Fruit	Fruit	Fruit	Fruit	Fruit	Fruit
Type		Plums	Plums	Plums	Plums	Blackberries	Blackberries	Blackberries
Radionuclides								
Tritium	(pCi/g)	0.273	0.284	<186	0.803	0.424	1.301	1.605
+/-2	sigma	0.09	0.091		0.11	0.098	0.126	0.134
K-40	(pCi/g)	1.366	1.495	1.534	1.323	1.220	1.086	0.177
+/-2	sigma	0.313	0.345	0.302	0.301	0.259	0.274	
MDA		0.157	0.158	0.156	0.148	0.163	0.163	
Cs-137	(pCi/g)	< 0.01689	< 0.01813	< 0.01837	< 0.01589	< 0.01752	0.063	< 0.01838
+/-2	sigma						0.019	
MDA							0.019	

Sample Location:		AKN202	AKN-203	WAG-201A	WAG-201B	WIN-201	LAU-201	WIL-204
Sample Date:		10/22/04	10/22/04	10/22/04	10/22/04	10/22/04	8/28/04	8/29/04
Matrix		Fruit	Fruit	Greens	Greens	Fruit	Fruit	Fruit
Type		Pears	Pears	Mustards	Collards	Persimmons	Scuppernongs	Passion Fruit
Radionuclides								
Tritium	(pCi/g)	0.266	<189	<189	<189	0.224	<189	0.189
+/-2	sigma	0.091				0.089		0.087
K-40	(pCi/g)	1.811	1.152	3.711	3.432	1.705	1.208	1.385
+/-2	sigma	0.3916	0.2586	0.7389	0.4695	0.3153	0.2613	0.3389
MDA		0.1964	0.1718	0.3225	0.1919	0.1553	0.1466	0.1555
Cs-137	(pCi/g)	< 0.02432	< 0.0191	< 0.04	< 0.0276	< 0.01799	< 0.01914	< 0.01641
+/-2	sigma							
MDA								

Note: The tritium concentrations in these tables represent only the distilled sample and not the tritium concentration in the entire vegetable sample.

Edible Vegetation Radiological Monitoring

Fruit

Sample Location:		ALN-201	ALN-203	SNL-201	SNL-203	SR-201	SR-202
Sample Date:		06/03/04	06/03/04	06/03/04	06/03/04	06/03/04	06/03/04
Radionuclides							
Tritium	(pCi/L)	273	284	<186	803	424	1301
+/-2	sigma	90	91		110	98	126
K-40	(pCi/g)	1.366	1.495	1.534	1.323	1.22	1.086
+/-2	sigma	0.313	0.345	0.302	0.301	0.259	0.274
MDA		0.157	0.158	0.156	0.148	0.163	0.163
Cs-137	(pCi/g)						0.063
+/-2	sigma						0.019
MDA							0.019

Fruit

Sample Location:		SR-203	AKN202	AKN-203	LAU-201	WIL-204	WIN-201
Sample Date:		06/03/04	10/22/04	10/22/04	8/28/2004	8/29/2004	10/22/2004
Radionuclides							
Tritium	(pCi/L)	1605	266	<189	<189	189	224
+/-2	sigma	134	91			87	89
K-40	(pCi/g)		1.811	1.152	1.208	1.385	1.705
+/-2	sigma		0.3916	0.2586	0.2613	0.3389	0.3153
MDA			0.1916	0.1718	0.1466	0.1555	0.1553
Cs-137	(pCi/g)		<0.02376	<0.01910	<0.01914	<0.01641	<0.01799
+/-2	sigma						
MDA							

Greens

Sample Location:		WAG-201A	WAG-201B
Sample Date:		10/22/04	10/22/2004
Radionuclides			
Tritium	(pCi/L)	<189	<189
+/-2	sigma		76
K-40	(pCi/g)	3.711	3.432
+/-2	sigma	0.7389	0.4695
MDA		0.3225	0.1919
Cs-137	(pCi/g)	<0.04	<0.02760
+/-2	sigma		
MDA			

3.3.4 Summary Statistics
Edible Vegetation Radiological Monitoring

Sample Location:	Sample Date:	Tritium pCi/g	Cs-137 pCi/g
ALN-201	6/3/04	0.273	
ALN-203	6/3/04	0.284	
SNL-201	6/3/04		
SNL-203	6/3/04	0.803	
SR-201	6/3/04	0.424	
SR-202	6/3/04	1.301	0.063
SR-203	6/3/04	1.605	
LAU-201	8/29/04		
WIL-204	8/28/04	0.189	
AKN202	10/22/04	0.266	
AKN-203	10/22/04		
WAG-201A	10/22/04		
WAG-201B	10/22/04		
WIN-201	10/22/04	0.224	

	Tritium	Cs-137
Average	**0.597**	**0.063**
Standard Deviation	**0.525**	**N/A**
Median	**0.284**	**0.063**

SRS Comparative Data

Sample Location	Sample Date	Media	Tritium pCi/g	Cs-137 pCi/g
SE Quadrant 0-10 miles	2/4/04	Greens	0.091	
NE Quadrant 0-10 miles	1/29/04	Greens		0.026
NW Quadrant 0-10miles	1/29/04	Greens		0.025
SE Quadrant 0-10 miles	2/4/04	Greens		0.045
SE Quadrant 25 miles	2/4/04	Greens		0.048
SW Quadrant 0-10 miles	2/11/04	Greens		0.047
Plant Perimeter-NW Quadrant	7/8/04	Fruit		0.051

	Tritium	Cs-137
Average	**0.091**	**0.404**
Standard Deviation	**N/A**	**0.170**
Median	**0.091**	**0.404**

3.4 Radiological Monitoring of Dairy Milk

3.4.1 Summary

The Department of Energy-Savannah River (DOE-SR) has historically conducted dairy milk monitoring of radionuclides around Savannah River Site (SRS). During 2004, DOE-SR collected cow milk samples from seven dairy locations. The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) collected dairy milk at seven cow dairy locations and three goat milk locations in 2004 to provide an independent source of data on concentrations of radionuclides in milk within a 50-mile radius of SRS.

ESOP personnel collected the cow milk samples on a quarterly basis in 2004 (Map 10, section 3.4.2). Many of the goat milk samples came from goats not normally milked for human consumption, and sampling was dependent on obtaining samples at the beginning of the weaning period of a meat goat kid during the springtime. The goat milk samples represent radioactive exposure for a unique group of subsistence goat milk consumers. No goat milk dairies are found within the 50-mile SRS perimeter of study.

Cow milk samples were analyzed for tritium, select gamma emitters (iodine-131, cesium-137, cobalt-60), and other specific radionuclides (strontium-89, strontium-90, iodine-129, uranium-234, uranium-235, uranium-238, and plutonium-239). Goat milk samples were analyzed for gamma emitters, strontium-89, and strontium-90. Additionally, the milk solids portion of some cow milk and goat milk samples was analyzed for strontium-90, and strontium-89.

RESULTS AND DISCUSSION

All analytical results are given in section 3.4.3 and all summary statistics are given in section 3.4.4.

<u>Tritium</u>

DOE-SR uses all data to calculate means including tritium data below the Minimum Detectable Activity (MDA). ESOP does not use numbers less than the corresponding MDA because they cannot be accurately quantified. All cow milk samples collected during 2004 had tritium levels that were below the MDA. The highest tritium value reported by DOE-SR was 242 pCi/L with an uncertainty of 88.4 pCi/L from a sample collected in Girard, GA (WSRC 2005). The highest value reported by DOE-SR in SC was 205 pCi/L with an uncertainty of 87.6 pCi/L from a sample collected in Denmark.

<u>Gamma emitting radionuclides</u>

ESOP REMD does not provide raw analytical data results below MDA; therefore, comparisons between ESOP and DOE-SR are difficult to assess because they are below reliable quantification.

Iodine-131, Cesium-137, and Cobalt-60 are all manmade radioactive elements. For the seven dairy locations participating in the ESOP milk-monitoring program, all analytical results for these radionuclides were below the respective MDA. Furthermore, analytical results for I-131 and Co-60 for samples collected from additional dairies that do not participate in the monitoring program were all below MDA. However, two of these locations did have detections for Cs-137. Location #33 had a concentration of 3.77 pCi/L with an uncertainty of 1.87 pCi/L (+/- 2 standard deviations (sd)), while location #35 had a concentration of 4.16 pCi/L with an uncertainty of 1.75 pCi/L (+/- 2sd). For the DOE-SR samples collected, the highest concentration recorded for Cs-137 was 3.51 pCi/L with an uncertainty of 1.20 pCi/L (+/- 2sd) at Girard, GA (WSRC 2005).

ESOP did not detect Cs-137, Co-60, or I-131 in goat milk. Furthermore, DOE-SR did not collect any goat milk during 2004.

Quarterly analysis of specific radionuclides

Strontium-89, 90 analysis was done on cow milk samples collected during the second quarter from the dairies that are not part of the annual sampling regime. Samples collected from two of these locations had detections for Sr-90. Location #33 had a concentration of 1.51 pCi/L with an uncertainty of 0.58 pCi/L (+/- 2sd), while location #35 had a concentration of 2.00 pCi/L with an uncertainty of 0.75 pCi/L (+/- 2sd). Additionally, samples from the second quarter were analyzed for U-234, 235, and 238. Three locations had detections for U-235 and U-238. Location #14 had a U-235 concentration of 0.033 pCi/L with an uncertainty of 0.030 pCi/L (+/- 2sd), location #10 had a U-238 concentration of 0.076 pCi/L with an uncertainty of 0.058 pCi/L (+/- 2sd), and location # 17 had a U-238 concentration of 0.122 pCi/L with an uncertainty of 0.100 pCi/L (+/- 2sd). Samples from the first and fourth quarter were analyzed for I-129 and Pu-239, respectively. All samples from these two quarters were less than the MDA. Samples collected during the third quarter were not analyzed for any specific radionuclides.

ESOP did detect Sr-89 and Sr-90 in goat milk collected from location # 7 and Sr-90 from location #4. Location # 7 had a concentration of 2.72 pCi/L with an uncertainty of 1.80 pCi/L (+/- 2sd) for Sr-89 and a concentration of 2.70 pCi/L with an uncertainty of 0.97 pCi/L (+/- 2sd) for Sr-90. Location #4 had a concentration of 2.96 pCi/L with an uncertainty of 1.40 pCi/L (+/- 2sd) for Sr-90.

Milk Solids

The milk solids portion of cow and goat milk samples collected during the second quarter was analyzed for Sr-89, 90. DOE-SR did not analyze milk solids, so no data comparison can be made. Milk solids data is given in section 3.4.4. Three of the sampling locations had detections for Sr-89. Location # 14 had a concentration of 52.4 pCi/L with an uncertainty of 39.0 pCi/L (+/- 2sd), location # 30 had a concentration of 61.2 pCi/L with an uncertainty of 43.0 pCi/L (+/- 2sd), and location # 35 had a concentration of 229.0 pCi/L with an uncertainty of 160.0 pCi/L (+/- 2sd).

Only one ESOP cow milk sampling location (location #35) and one goat milk sampling location (location #4) had milk and milk solid analyses performed for the same radionuclide (Sr-89, 90). The whole milk Sr-90 analysis for the cow milk sample yielded a concentration of

2.00 pCi/L with an uncertainty of 0.75 pCi/L (+/- 2sd), whereas the milk solid analysis results were below the MDA. Furthermore, the whole milk Sr-89 analysis results were below the MDA, whereas the milk solid analysis yielded a concentration of 229.0 pCi/L with an uncertainty of 160.0 pCi/L (+/- 2sd). Additionally, the whole milk Sr-90 analysis for goat milk yielded a concentration of 2.96 pCi/L with an uncertainty of 1.40 pCi/L (+/- 2sd). The goat milk solid analysis results for Sr-90 were below the MDA. The whole milk and milk solid Sr-89 analysis results for goat milk were below the MDA.

Summary Statistics

There were no detects for tritium in milk samples collected by ESOP. Therefore, no summary statistics could be calculated for tritium. For gamma emitting radionuclides, there were only two detects for Cs-137. The Cs-137 "detects only" average for ESOP milk samples was 3.97 pCi/L with an uncertainty of 0.28 pCi/L (+/- 2sd). Additionally, there were only two detects for Sr-90. The Sr-90 "detects only" average for cow milk samples was 1.76 pCi/L with an uncertainty of 0.35 pCi/L (+/- 2sd). Only one ESOP sampling location (#14) had a detect for U-235 (0.033 pCi/L with an uncertainty of 0.030 pCi/L (+/- 2sd)). Additionally, only one location (#10) had a detect for U-238 (0.076 pCi/L with an uncertainty of 0.058 pCi/L (+/- 2 sd)). The "detects only" average for Sr-89 in cow milk solids was 114.20 pCi/L with an uncertainty of 61.2 pCi/L (+/- 2sd). Goat milk only had one detect for Sr-89 (2.72 pCi/L with an uncertainty of 1.80 pCi/L (+/- 2sd)) and a "detects only" average for Sr-90 of 2.83 pCi/L with an uncertainty of 0.18 pCi/L (+/- 2sd).

ESOP only had two radionuclides in common with DOE-SR where detects were encountered. DOE-SR reports results for Sr-89, 90 collectively, whereas ESOP reports results for each radionuclide separately. Therefore, no comparison of Sr data between ESOP and DOE-SR can be made. ESOP and DOE-SR only have one sampling location in common (Denmark, SC). However, ESOP did not have any detects from samples collected from the Denmark dairy. ESOP did have one background location and one perimeter location that had a detect for Cs-137. Since ESOP only collected samples in South Carolina, only the DOE-SR average for the South Carolina location (Denmark, SC) was used for comparison. Additionally, the "detects only" average was used for both monitoring programs. The "perimeter" minus "background" (E-B) result for the ESOP data was 0.39 pCi/L. The DOE-SR average for Cs-137 was 0.86 pCi/L with an uncertainty of 1.10 pCi/L. The ESOP "E-B" value is within one standard deviation of the DOE-SR average for Cs-137. Therefore, the Cs-137 results reported by DOE-SR are generally in agreement with the ESOP results.

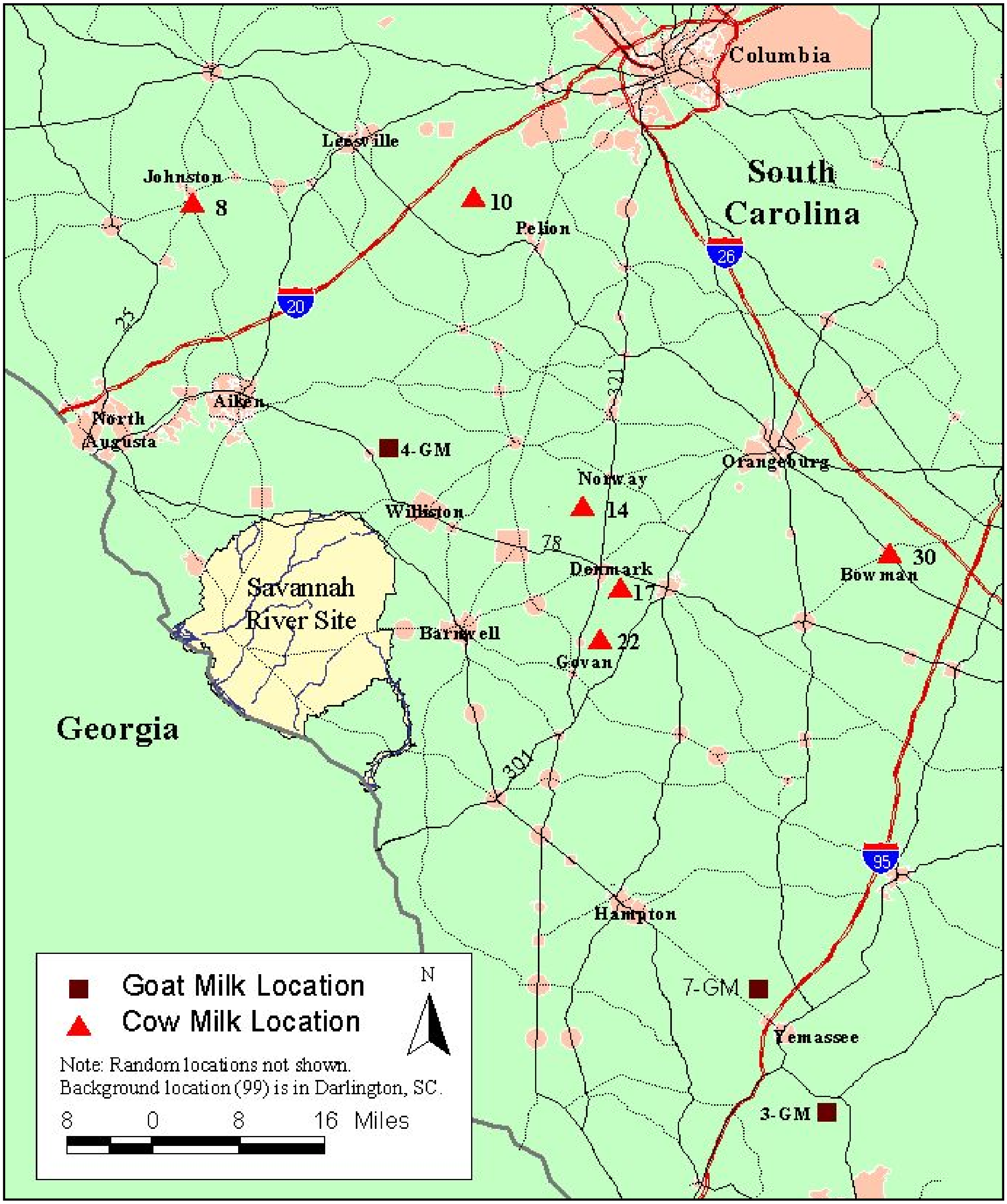
CONCLUSIONS AND RECOMMENDATIONS

The DOE-SR uses all analytical results, including below minimum detection levels (MDL), to compute means. Therefore, dairy milk analytical data comparisons between ESOP and DOE-SR are limited in scope. Due to the low number of detects, no statistical comparison between ESOP and DOE-SR data was conducted.

Tritium was not detected in any ESOP milk samples. This may be due to high laboratory detection limits. Lower detection levels may result in more detects being identified, therefore providing a better comparison with DOE-SR results.

A large portion of the radioactive contamination observed in collected milk samples can be attributed to fallout from past nuclear testing. Additionally, radionuclides within soil and plants can potentially be redistributed as a result of farming practices and controlled burns. ESOP will continue to monitor cow and goat dairy milk to ensure the safety of milk consumption by the public.

3.4.2
Map 10. Radiological Monitoring Locations for Dairy Milk



3.4.3 Data
Dairy Milk Monitoring

Radiological Monitoring of Dairy Milk
Cow Milk

Sample Location:		#8			
Sample Date:		1/21/04	6/24/04	9/23/04	11/23/04
Tritium	(pCi/L)	<LLD	NS	<LLD	<LLD
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	256		264	249
I-131	(pCi/L)	<MDA	NS	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	7.093		5.046	373.8
Cs - 137	(pCi/L)	<MDA	NS	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.209		1.588	2.412
Co - 60	(pCi/L)	<MDA	NS	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	1.980		1.511	2.232

Sample Location:		#10			
Sample Date:		1/13/04	6/30/04	9/23/04	11/23/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	254	259	264	247
I-131	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	8.855	3.408	5.476	4.158
Cs - 137	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.087	1.612	1.612	2.598
Co - 60	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	1.829	1.477	1.546	2.325

Notes:

1. NS = No Sample
2. LLD = Lower Limit of Detection
3. MDA = Minimum Detectable Activity
4. sd=standard deviation

Radiological Monitoring of Dairy Milk
Cow Milk

Sample Location:		#14			
Sample Date:		1/14/04	6/25/04	9/21/04	11/18/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	256	260	264	249
I-131	(pCi/L)	<MDA	<MDA	<MDA	More Than
Uncertainty	(+/- 2 sd)				8 Half Lives
MDA	(pCi/L)	12.91	4.999	5.207	Has Elapsed
Cs - 137	(pCi/L)	<MDA	<MDA	<MDA	
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.108	1.637	1.591	2.433
Co - 60	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.070	1.593	1.684	1.998

Sample Location:		#17			
Sample Date:		1/16/04	6/24/04	9/21/04	11/18/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	255	260	262	258
I-131	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	7.846	4.869	5.275	365.3
Cs - 137	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.110	1.755	1.581	2.622
Co - 60	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	1.882	1.697	1.411	2.486

Notes:

1. LLD = Lower Limit of Detection
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

Radiological Monitoring of Dairy Milk
Cow Milk

Sample Location:		#22			
Sample Date:		1/14/04	6/24/04	9/22/04	11/19/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	256	258	265	249
I-131	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	11.87	5.295	5.357	473.9
Cs - 137	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.139	1.541	1.636	2.604
Co - 60	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.033	1.651	1.628	2.362

Sample Location:		#30			
Sample Date:		1/15/04	6/25/04	9/22/04	11/19/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
LLD	(pCi/L)	252	260	264	250
I-131	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	8.160	5.381	5.392	511.9
Cs - 137	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.154	1.792	1.71	2.629
Co - 60	(pCi/L)	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)				
MDA	(pCi/L)	2.031	1.714	1.644	2.532

Notes:
1. LLD = Lower Limit of Detection
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

Radiological Monitoring of Dairy Milk
Cow Milk

Sample Location:		#99	
Sample Date:		9/30/04	07/12/04
Tritium	(pCi/L)	<LLD	<LLD
Uncertainty	(+/- 2 sd)		
LLD	(pCi/L)	263	248
I-131	(pCi/L)	<MDA	<MDA
Uncertainty	(+/- 2 sd)		
MDA	(pCi/L)	3.867	129.2
Cs-137	(pCi/L)	<MDA	<MDA
Uncertainty	(+/- 2 sd)		
MDA	(pCi/L)	1.611	2.646
Co-60	(pCi/L)	<MDA	<MDA
Uncertainty	(+/- 2 sd)		
MDA	(pCi/L)	1.675	2.312

Sample Location:		#33	#34	#35
Sample Date:		4/13/04	4/15/04	5/6/04
Tritium	(pCi/L)	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)			
LLD	(pCi/L)	263	264	261
I-131	(pCi/L)	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)			
MDA	(pCi/L)	296.900	323.100	51.61
Cs-137	(pCi/L)	**3.77**	1.88	**4.16**
Uncertainty	(+/- 2 sd)	**1.87**		**1.75**
MDA	(pCi/L)	**1.72**	<MDA	**1.80**
Co-60	(pCi/L)	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)			
MDA	(pCi/L)	1.998	1.876	1.885

Notes:

1. LLD = Lower Limit of Detection
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

Radiological Monitoring of Dairy Milk
Cow Milk

1st Quarter

Sample Location:		#10	#14	#17	#22	#30	#8
Sample Date:		13 JAN 04	14 JAN 04	16 JAN 04	14 JAN 04	15 JAN 04	21 JAN 04
I-129	(pCi/L)	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)						
MDA	(pCi/L)	20.8	21.1	20.4	20.8	19.6	21.6

1. All samples < MDA
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

2nd Quarter

Sample Location:		#33	#34	#35
Sample Date:		13 APR 04	15 APR 04	06 MAY 04
Sr-89	(pCi/L)	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)			
MDA	(pCi/L)	0.738	1.070	0.594

Sample Location:		#33	#34	#35
Sample Date:		13 APR 04	15 APR 04	06 MAY 04
Sr-90	(pCi/L)	**1.51**	<MDA	**2.00**
Uncertainty	(+/- 2 sd)	**0.58**		**0.75**
MDA	(pCi/L)	**0.86**	1.46	**1.12**

NOTES:
1. Detects are in bold.
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

2nd Quarter

Sample Location:		#10	#14	#22	#30	#17
Sample Date:		30 JUN 04	25 JUN 04	24 JUN 04	25 JUN 04	24 JUN 04
U-234	(pCi/L)	<MDA	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)					
MDA	(pCi/L)	0.075	0.049	0.115	0.111	0.219

Sample Location:		#10	#14	#22	#30	#17
Sample Date:		30 JUN 04	25 JUN 04	24 JUN 04	25 JUN 04	24 JUN 04
U-235	(pCi/L)	<MDA	**0.033**	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)		**0.030**			
MDA	(pCi/L)	0.064	**0.018**	0.102	0.062	0.189

Sample Location:		#10	#14	#22	#30	#17
Sample Date:		30 JUN 04	25 JUN 04	24 JUN 04	25 JUN 04	24 JUN 04
U-238	(pCi/L)	**0.076**	<MDA	<MDA	<MDA	**0.122**
Uncertainty	(+/- 2 sd)	**0.058**				**0.100**
MDA	(pCi/L)	**0.075**	0.079	0.121	0.111	**0.055**

NOTES:
1. Detects are in bold.
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

4th Quarter

Sample Location:		#10	#14	#17	#22	#30	#8	#99
Sample Date:		23 NOV 04	18 NOV 04	18 NOV 04	19 NOV 04	19 NOV 04	23 NOV 04	07 DEC 04
Pu-239	(pCi/L)	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)							
MDA	(pCi/L)	0.222	0.255	0.153	0.111	0.123	0.272	0.269

1. All samples < MDA
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

Radiological Monitoring of Dairy Milk
Milk Solids From Dairy Cow Milk

Sample Location:		#14	#22	#30	#35	#4GM
Sample Date:		25 JUN 04	24 JUN 04	25 JUN 04	06 MAY 04	06 MAY 04
Sr-89	(pCi/L) dry	**52.4**	<MDA	**61.2**	**229.0**	<MDA
Uncertainty	(+/- 2 sd)	**39.0**		**43.0**	**160.0**	
MDA	(pCi/L) dry	**27.0**	32.7	**33.1**	**205.0**	204.0

Sample Location:		#14	#22	#30	#35	#4GM
Sample Date:		25 JUN 04	24 JUN 04	25 JUN 04	06 MAY 04	06 MAY 04
Sr-90	(pCi/L) dry	<MDA	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sd)					
MDA	(pCi/L) dry	3.2	3.7	3.2	5.0	5.9

1. Detects are in bold.
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

Radiological Monitoring of Dairy Milk
Goat Milk

Sample Location:		#3GM	#4GM	#7GM
Sample Date:		02 MAY 04	06 MAY 04	26 MAR 04
Sr-89	(pCi/L)	<MDA	<MDA	**2.72**
Uncertainty	(+/- 2 sd)			**1.80**
MDA	(pCi/L)	0.89	1.24	**1.41**

Sr-90	(pCi/L)	<MDA	**2.96**	**2.70**
Uncertainty	(+/- 2 sd)		**1.40**	**0.97**
MDA	(pCi/L)	2.13	**2.37**	**1.39**

1. Detects are in bold.
2. MDA = Minimum Detectable Activity
3. sd=standard deviation

3.4.4 Summary Statistics
Radiological Monitoring of Dairy Milk

Detects only averages for milk samples

COW MILK		ESOP	
Radionuclide	AVERAGE	ST DEV	MEDIAN
Cs-137	3.97	0.28	3.97
Sr-90	1.76	0.35	1.76
U-235	0.0331	NA	0.0331
U-238	0.0991	0.0324	0.0991

MILK SOLIDS FROM COW MILK			
Radionuclide	AVERAGE	ST DEV	MEDIAN
Sr-89	114.20	99.52	61.20

GOAT MILK			
Radionuclide	AVERAGE	ST DEV	MEDIAN
Sr-89	2.72	NA	2.72
Sr-90	2.83	0.18	2.83

4.1 Radiological Fish Monitoring Associated With SRS

4.1.1 Summary

The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) conducts fish monitoring for radionuclide activity in an effort to determine the magnitude, extent, and trends of radionuclide levels. Five largemouth bass (*Micropterus salmoides)* and five catfish (*Ameiurus catus* or *Ictalurus punctatus*) were collected from nine sample locations. Studies have shown that these species bioaccumulate measurable amounts of radionuclides. Striped mullet (*Mugil cephalus*) and/or American shad (*Alosa sapidissima*) were collected from four locations as part of an ongoing effort to sample additional species each study year.

Fish were collected using boat mounted electrofishing equipment. Samples were collected at five stations where creeks from the Savannah River Site (SRS) meet the Savannah River. In addition, samples were collected at one Savannah River station upstream of the SRS, two stations downstream of the SRS, and one background location. All fish were composited by species and sample location, and separated into edible and nonedible homogeneous portions. Edible composites were analyzed for gamma-emitting isotopes and tritium. Nonedible composites were analyzed for gamma-emitters and strontium. Sampling locations are located in section 4.1.2.

The Department of Energy-Savannah River (DOE-SR) also conducts fish monitoring to assess the environmental effects of current and historical releases of radionuclides. ESOP data were compared to DOE-SR reported results. Discrepancies in these results could be attributed to the natural variation of radionuclide levels. Although there are differences between reported values, the data is consistent with historically reported data. In the past, samples have been collected and split between ESOP and DOE-SR for analyses, and no discrepancies in the data results were found. This would potentially rule out methodology differences and substantiate that differences result from the variability in samples analyzed by the two programs.

Independent monitoring of radionuclide levels in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. The information provided will assist in advising, informing, and protecting the people at risk, and in comparing current and historical data. The additional species collected in 2005 will be sunfish (Family:Centrarchidae).

RESULTS AND DISCUSSION

Fish collections were conducted from March 22 through July 12, 2004 (Map 11, section 4.1.2). Largemouth bass were collected for the predator ecological finfish type. Channel catfish were collected at all the Savannah River locations in 2004 for the bottom-feeders ecological finfish type; one white catfish was collected at the Stevens Creek location. Striped mullet were collected at three locations on the Savannah River and American shad were collected at two.

A total of 109 fish was collected. Forty-six composites and two individual fish samples were processed in the EQC laboratory. The EQC tritium laboratory analyzed aliquots from all edible samples. Edible and non-edible samples were sent to the REMD for radiological analysis of gamma-emitting radionuclides. Portions of the non-edible samples were sent to STL for

strontium analysis. Activity levels of radionuclides for Savannah River fish and ESOP historical data from 2000 – 2004 are reported in section 4.1.4. Summary statistics are presented in section 4.1.5. Tritium results represent the activity level in the water distilled from the fish tissue. Cesium results represent the activity level in the wet sample itself. Strontium results represent the activity level in an aliquot of dried fish tissue.

Tritium

Activity levels of tritium were analyzed in 23 edible portions of bass, catfish, mullet, and American shad composites and one individual sample. The Stevens Creek and NSBLD locations were the only sampling areas that did not produce detectable tritium activity in any samples (Figure 1a, section 4.1.3). The Stevens Creek station is located above a spillway for a hydroelectric generating plant, which completely blocks movement of fish from the lower Savannah River.

Five of eight bass samples from the Savannah River produced detectable tritium activity, with an average of 1897 pCi/L. The composite from the Steel Creek location had the highest reported tritium activity, 3442 pCi/L.

Seven Savannah River catfish samples exhibited tritium activity, with an average of 1043 pCi/L. The highest tritium level observed in the catfish composites, 3761 pCi/L, was from the Fourmile Creek location.

Two of the three mullet samples showed tritium activity, 947 and 1953 pCi/L. One of the two shad samples produced tritium activity, 285 pCi/L, from the Steel Creek location.

Samples from downstream of SRS exhibited tritium activities similar to samples collected near SRS streams. In general, 2004 data was consistent with ESOP historically reported data (Figures 1b,1c, section 4.1.3) (SCDHEC 2004).

Cesium

Activity levels of Cs-137 were analyzed in 46 edible and nonedible portions of bass, catfish, mullet, and shad composites and two individual samples. The Stevens Creek background location, NSBLD, and Hwy. 301 were the only locations where Cs-137 was not detected in any sample (Figure 2a/3a, section 4.1.3,). None of the mullet or shad samples showed cesium activity. Consistent with historically reported ESOP data, higher levels of Cs-137 were reported at the locations adjacent to the SRS (Figure 2b,2c/3b,3c, section 4.1.3,) (SCDHEC 2004).

Six of nine edible bass composites from Savannah River locations produced detectable levels of Cs-137, ranging from 0.056 to 0.566 pCi/g, with an average of 0.178 pCi/g. The sample from the Lower Three Runs location had the highest reported activity level. Cs-137 levels reported above 0.06 pCi/g were observed in all edible bass composites from the five locations adjacent to the SRS. The level for edible bass at the Stokes Bluff Landing was reported at 0.056 pCi/g fresh weight. Cesium was not detected in bass from the Hwy. 301 Bridge area. Cs-137 activity in nonedible bass composites was detected only from four creek mouth locations adjacent to SRS. Only three edible catfish composites, from locations adjacent to SRS, produced detectable levels of Cs-137. The Cs-137 levels in these catfish composites ranged from 0.071 to 0.316 pCi/g. Two nonedible composites produced detectable Cs-137 activity. The Fourmile Creek location produced the highest activity in the edible sample, Lower Three Runs for the nonedible sample.

Strontium

Portions of 20 nonedible composites and one individual fish sample were selected for strontium analysis in 2004, although one sample result was not used due to laboratory error. Four samples exhibited activity greater than the MDA, ranging from 0.113 to 0.212 pCi/g (Figure 4a, section 4.1.3). The highest activity level reported was in a bass sample from the Steel Creek location. Figures 4b and 4c Section 4.1.3 show historically reported ESOP data for Sr-90 (SCDHEC 2004).

Individual Fish Analyses

Larger, older fish may bioaccumulate more contaminants over time (USEPA 2000). ESOP analyzed and compared data from a single large fish versus the composite it was a part of in order to ascertain the impact a large fish might have on a composite sample. One bass was harvested for separate analyses from the Fourmile Creek location.

The results demonstrate the variability that can be encountered among separate fish.

An aliquot of the edible single sample portion was analyzed for tritium. No tritium was detected in the individual sample while the corresponding composite sample produced the highest tritium result for bass, 3442 pCi/L, in 2004.

Results of the cesium-137 analysis of the edible single and composite samples were 0.046 and 0.086 pCi/g, respectively. The nonedible single sample portion did not produce detectable Cs-137. The result for the composite was 0.058 pCi/g. An aliquot of the nonedible portion of the single bass were analyzed for Sr-90, with no activity found above the MDA. The composite sample was 0.208 pCi/g.

DOE-SR / ESOP Comparison

ESOP bass and catfish data collected for this project in 2004 was compared to DOE-SR reported information (WSRC 2005). Data comparison summaries are located in section 4.1.4. One difference between the two programs is that ESOP analyzes one composite type from each species for each location, whereas the DOE-SR program analyzes three per location. Therefore, a single composite for an ESOP location was compared to the average of the three DOE-SR composites reported.

Neither ESOP nor DOE-SR found detectable tritium levels at the location upstream of SRS near Augusta, Georgia (section 4.1.4). From the Fourmile Creek location down-stream to the Hwy. 301 bridge, ESOP tritium values from largemouth bass were consistently higher than the DOE-

SR data. Tritium levels in catfish from Fourmile Creek and Hwy. 301 were also higher in ESOP samples than the DOE-SR values. Cs-137 results for bass and catfish from ESOP and DOE-SR were less than 1.00 pCi/g or non-detects for both programs. ESOP and DOE-SR Sr-89,90 values were less than or equal to 0.25 pCi/g or non-detects for both programs. Discrepancies in these results could be attributed to the natural variation in bioaccumulation among individual fish, as evidenced by the extreme variation in the single versus composite fish samples analyzed by ESOP.

For direct comparisons of data between the two programs, only averages of detections were used. For tritium in largemouth bass, DOE-SR results were within two standard deviations (section 4.1.5) of the ESOP results; catfish results were within one standard deviation. For Cs-137 in both edible bass and edible catfish samples, DOE-SR results were within one standard deviation of the ESOP results. For non-edible samples, DOE-SR results for bass were within two standard deviations of ESOP results, but catfish results were outside of three standard deviations. Sr-89,90 results for bass were within two standard deviations, while catfish results were identical for the two programs.

CONCLUSIONS AND RECOMMENDATIONS

A review of ESOP data indicates that DOE-SR operations have impacted fish. Higher levels of radionuclides are found in Savannah River fish collected adjacent to and downstream of SRS compared to upstream. Fish from background locations tend not to exhibit detectable levels of man-made radionuclides.

The project attempted to determine if activity levels in larger fish might impact a composite of relatively smaller fish. Separate portions of one bass, considerably larger than the other fish sampled, were analyzed and compared to their respective composites. Although results of the gamma and strontium analyses showed no large differences between the samples, the tritium results were markedly different. If nothing else, these results demonstrate the variability that can be found among individuals in a population. Collections of larger fish will continue in 2005 to provide additional data for assessment.

ESOP project data was compared to DOE-SR reported information (WSRC 2005). Compared tritium data were not similar for locations where activity was detected, although reported values for Cs-137 and Sr-89,90 were generally similar**.** Discrepancies in results could be due to the natural variation of radionuclide levels in individual fish.

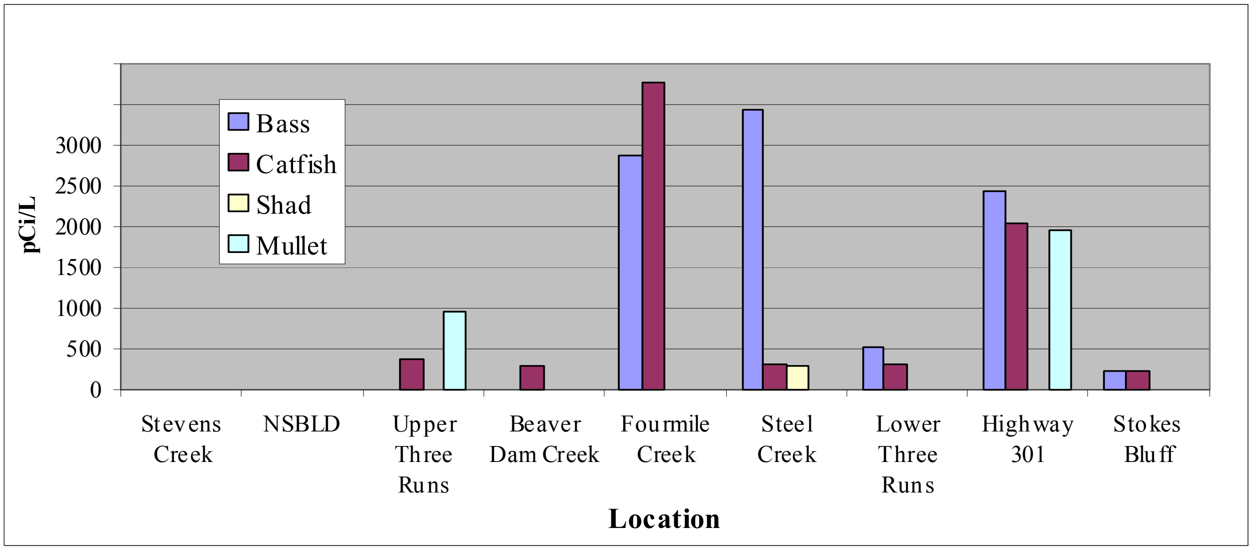
The ESOP 2004 fish collections included striped mullet, a species listed in the 2004 South Carolina Fish Consumption Advisories (SCDHEC 2004), and American shad. The ESOP monitoring program will collect additional species in 2005 in addition to the target species. The species collected will be from the Sunfish family (Centrarchidae). This will augment the existing data on Savannah River fish, and provide information for human health assessment.

Independent monitoring of radionuclide levels in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. Continued monitoring will provide a better understanding of actual radionuclide levels, their extent, and trends. Several important benefits can be realized as a result. Foremost is the ability for SCDHEC Bureau of

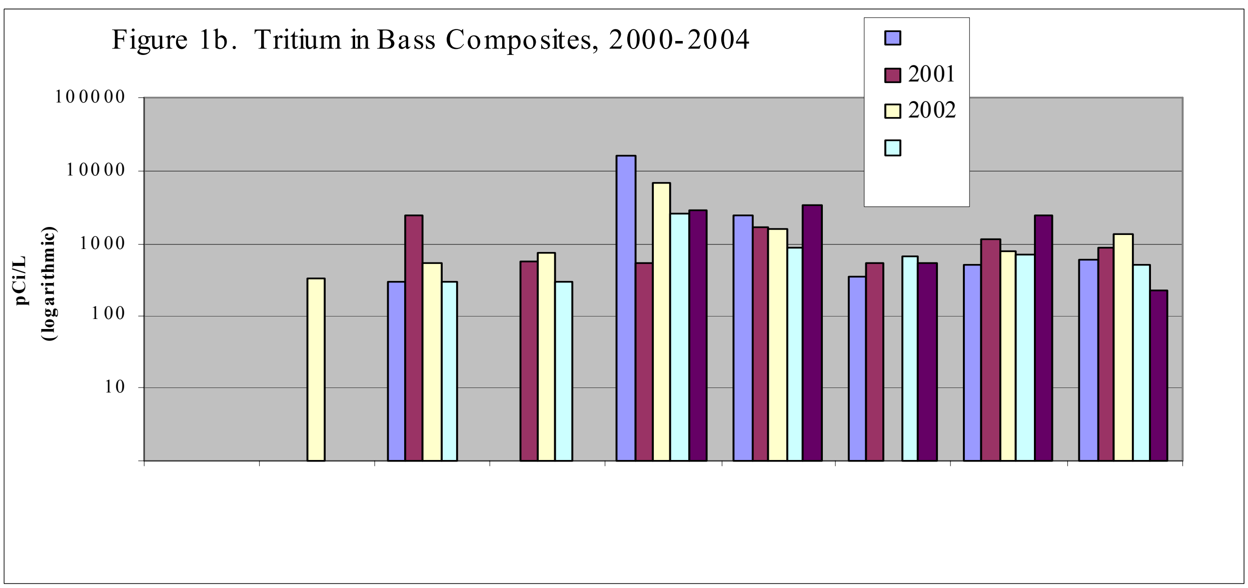
Water and the Division of Health Hazard Evaluation to further evaluate the potential human health risk associated with consumption of Savannah River fish. SCDHEC will be able to better advise, inform, and protect those people at risk. Another benefit will be the ability to compare this data with historical data. Data comparison will also be part of the further evaluation of the DOE-SR program, allowing the data reported by DOE-SR to be verified. This independent verification will provide credibility and confidence in the DOE-SR data and its uses.

4.1.2
Map 11. Radiological Monitoring of Fish Associated With SRS

4.1.3 Tables and Figures
Radiological Fish Monitoring



1. Channel catfish collected at all locations except Stevens Creek, where one white catfish was collected.
2. American shad collected only at NSBLD and Steel Creek.
3. Striped mullet collected only at NSBLD, Upper Three Runs, and Highway 301



Tables and Figures
Radiological Fish Monitoring

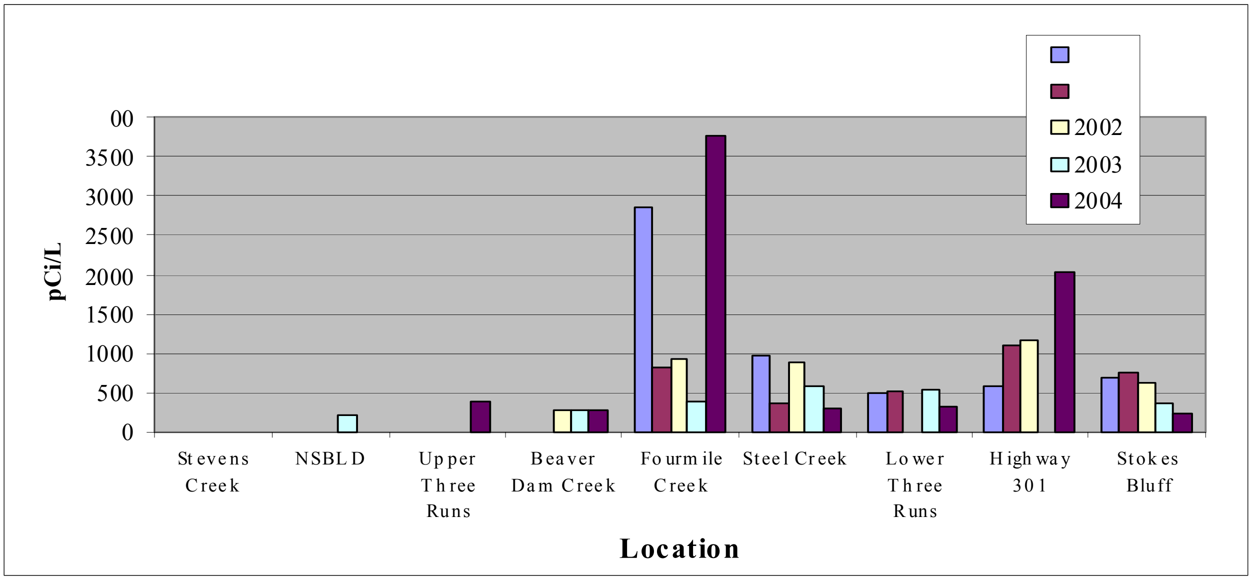
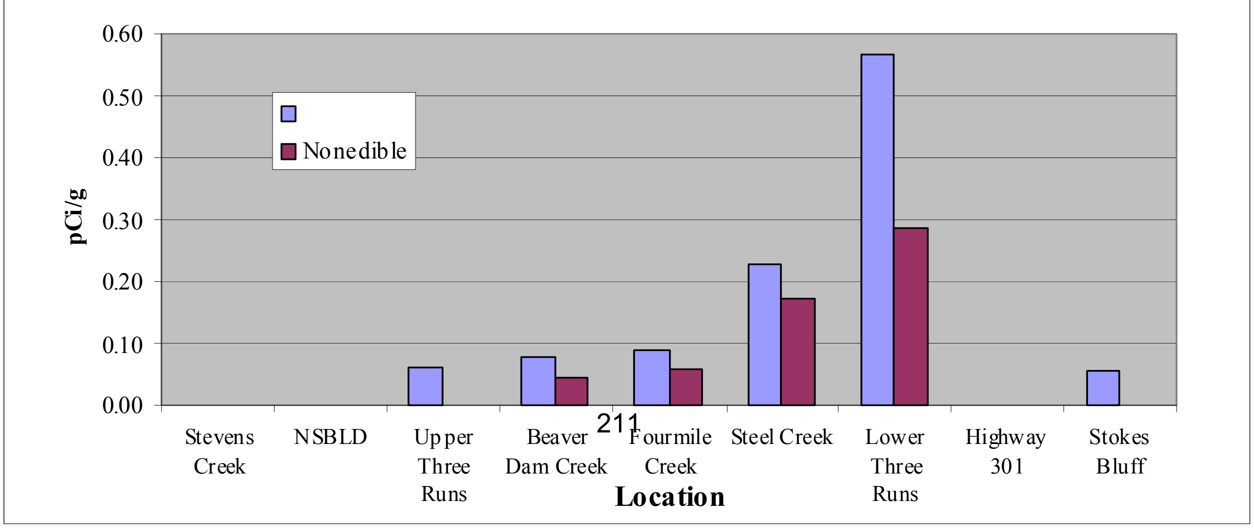


Figure 2a. Cesium-137 in Bass Composites, 2004



Tables and Figures
Radiological Fish Monitoring

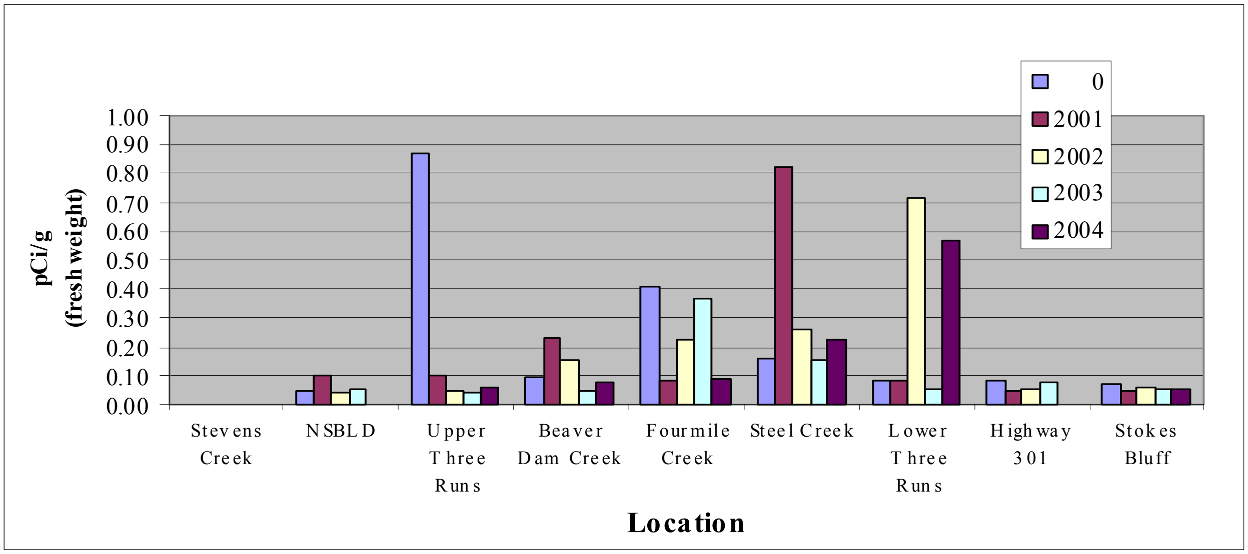
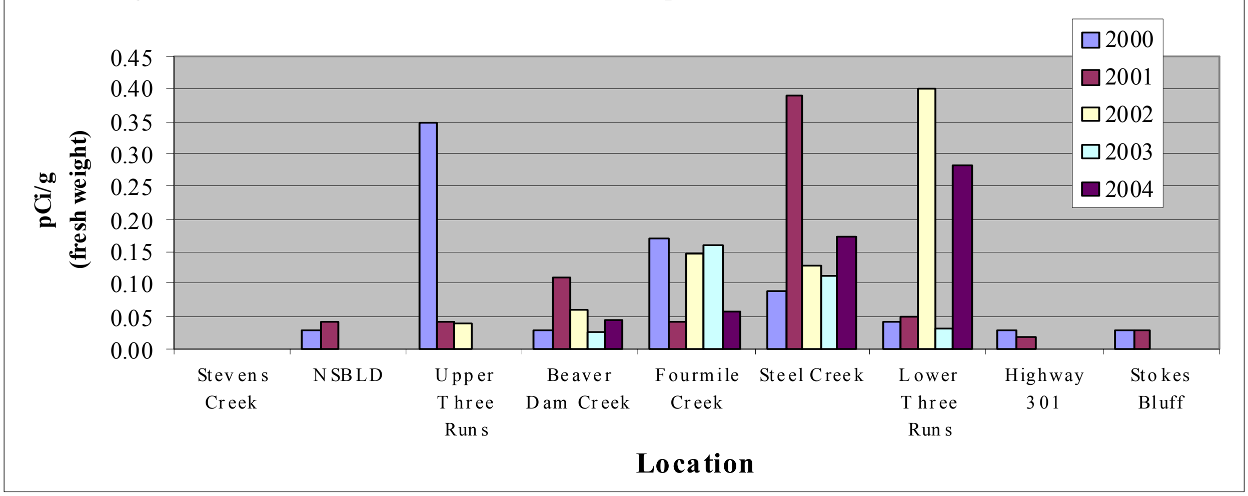
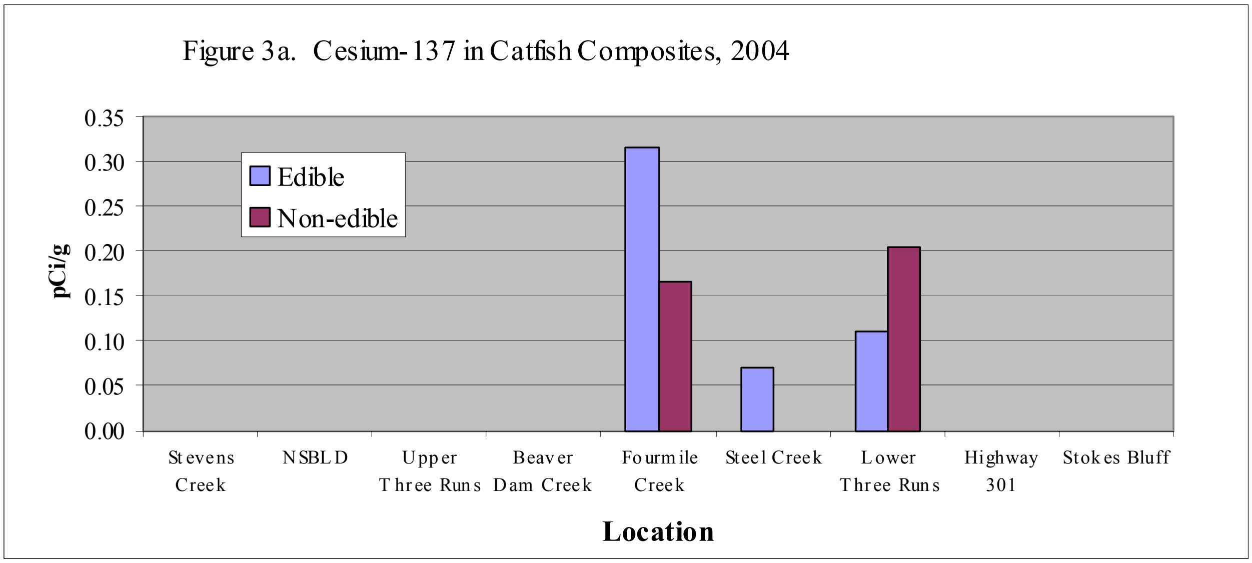
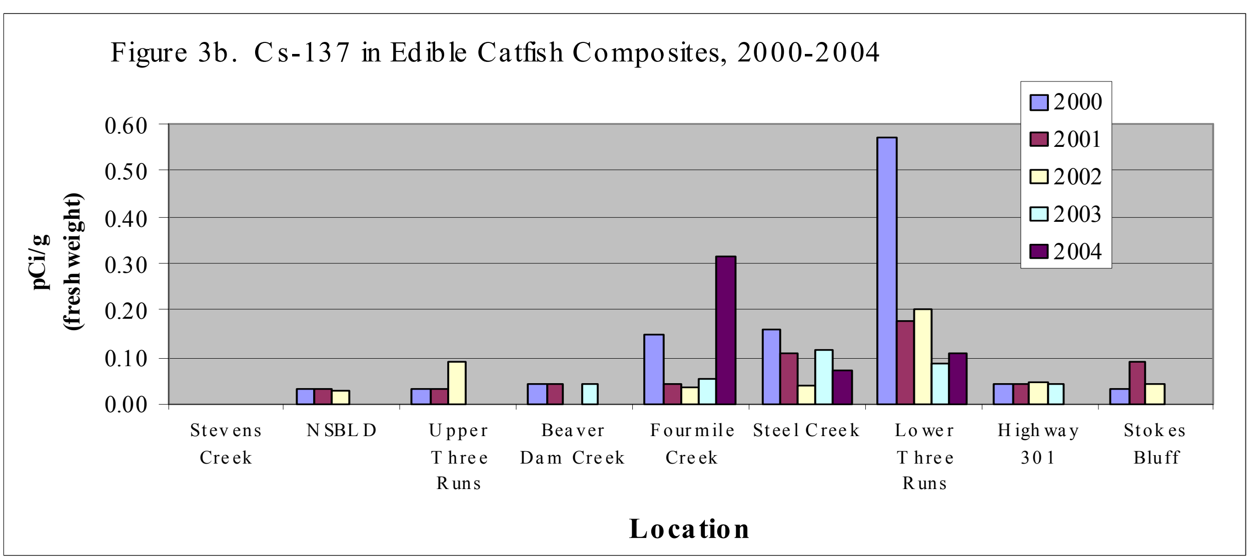


Figure 2c. Cs-137 in Non-edible Bass Composites, 2000-2004

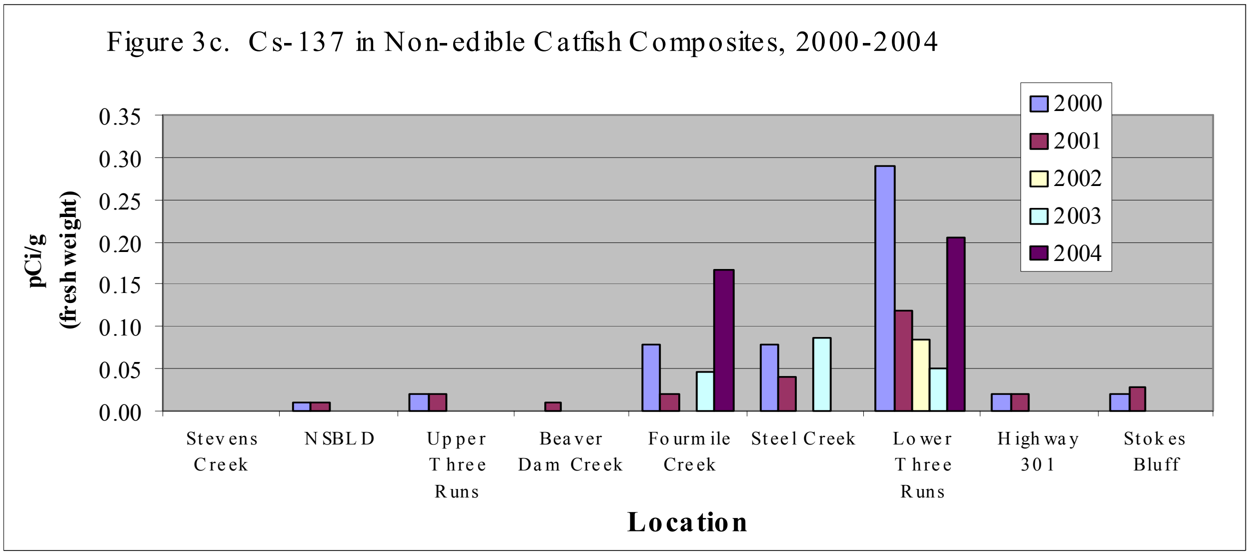


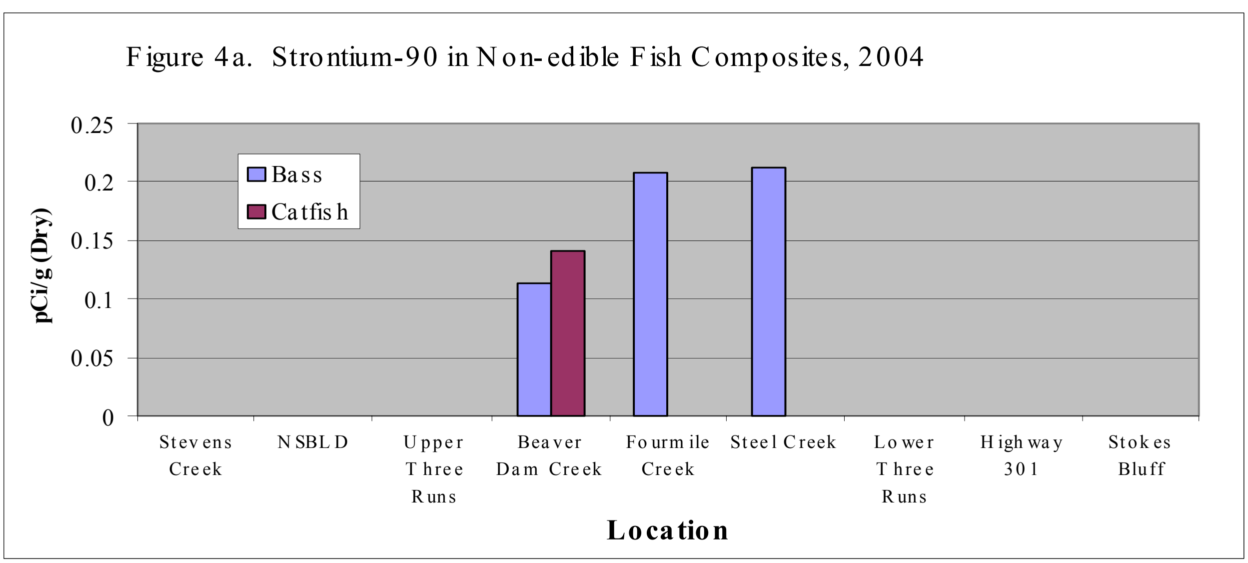
Tables and Figures
Radiological Fish Monitoring



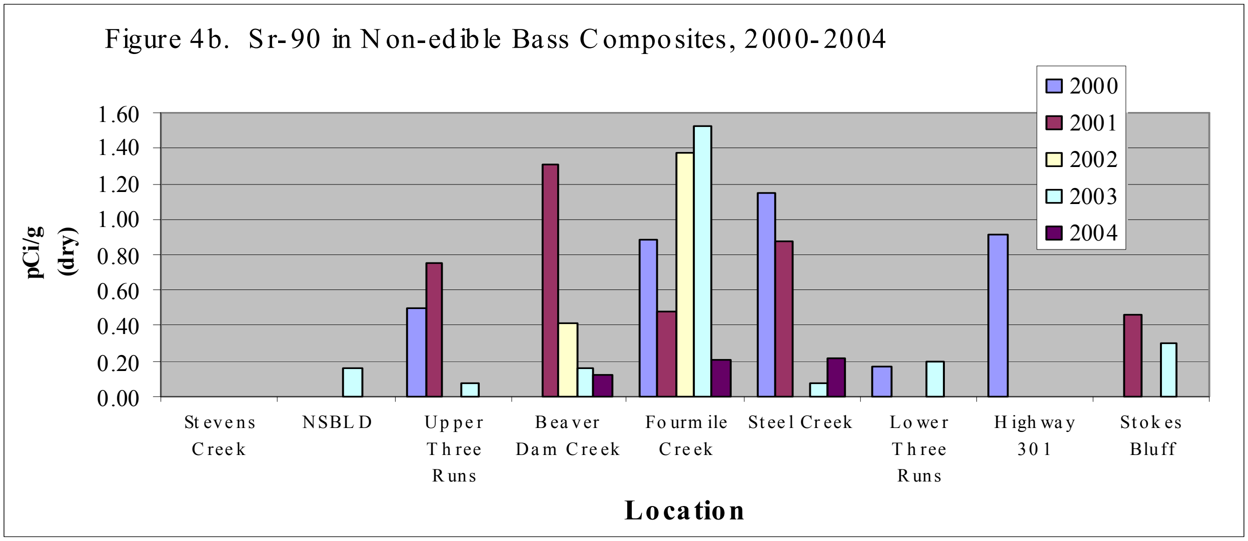


Tables and Figures
Radiological Fish Monitoring

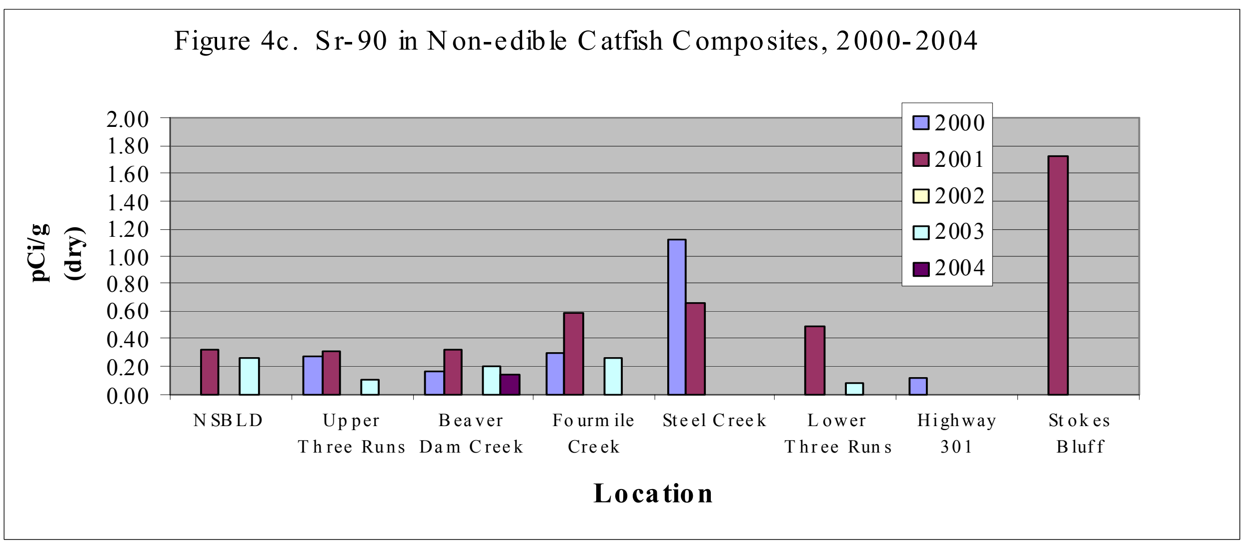




Tables and Figures
Radiological Fish Monitoring



1. NSBLD analyzed only in 2003
2. Stokes & Congaree analyzed only in 2001and 2003
3. STC not analyzed in 2002
4. BDC not analyzed in 2000.



1. NSBLD, Stokes, Congaree analyzed only in 2001 and 2003.

4.1.4 Data
Radiological Monitoring of Fish in the Savannah River

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Stevens Creek	Stevens Creek	Stevens Creek	Stevens Creek
Sample Station		SV-2059	SV-2059	SV-2059	SV-2059
Sample Date		5/13/2004	5/13/2004	5/13/2004	5/13/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish*	Catfish*
	Tritium (pCi/L)	<193	Not Analyzed	<193	Not Analyzed
	+/- 2 Sigma				
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma				
	MDA	0.019	0.021	0.024	0.021
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	**Lab Error**
	+/- 2 Sigma				
	MDA		1.04		
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed	**Lab Error**
	+/- 2 Sigma				
	MDA		0.335		

*Only one white catfish collected

Sample Location		NSBLD	NSBLD	NSBLD	NSBLD
Sample Station		SV-2028	SV-2028	SV-2028	SV-2028
Sample Date		3/26/2004	3/26/2004	3/26/2004	3/26/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish	Catfish
	Tritium (pCi/L)	<197	Not Analyzed	<197	Not Analyzed
	+/- 2 Sigma				
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma				
	MDA	0.021	0.019	0.022	0.020
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.462		0.439
	Sr-90 (Dry)	Not Analyzed	0.140	Not Analyzed	Non-detect
	+/- 2 Sigma		0.071		
	MDA		0.114		0.102

NSBLD - New Savannah Bluff Lock & Dam
Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		NSBLD	NSBLD	NSBLD	NSBLD
Sample Station		SV-2028	SV-2028	SV-2028	SV-2028
Sample Date		3/26/2004	3/26/2004	3/26/2004	3/26/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Striped mullet	Striped mullet	American shad	American shad
	Tritium (pCi/L)	<197	Not Analyzed	<197	Not Analyzed
	+/- 2 Sigma				
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma				
	MDA	0.021	0.027	0.023	0.020
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.500		0.485
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.133		0.114

Sample Location		Upper Three Runs	Upper Three Runs	Upper Three Runs
Sample Station		SV-2011	SV-2011	SV-2011
Sample Date		3/31/2004	3/31/2004	3/31/2004
Sample Cut		Edible	Non-edible	Edible
Species		Bass	Bass	Catfish
	Tritium (pCi/L)	<197	Not Analyzed	377
	+/- 2 Sigma			98
Radionuclides (pCi/g)	Cs-137 (fresh)	0.061	Non-detect	Non-detect
	+/- 2 Sigma	0.026		
	MDA	0.023	0.017	0.022
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed
	+/- 2 Sigma			
	MDA		0.430	
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed
	+/- 2 Sigma			
	MDA		0.113	

NSBLD - New Savannah Bluff Lock & Dam
Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Upper Three Runs	Upper Three Runs	Upper Three Runs
Sample Station		SV-2011	SV-2011	SV-2011
Sample Date		3/31/2004	3/31/2004	3/31/2004
Sample Cut		Non-edible	Edible	Non-edible
Species		Catfish	Striped mullet	Striped mullet
	Tritium (pCi/L)	Not Analyzed	947	Not Analyzed
	+/- 2 Sigma		118	
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma			
	MDA	0.015	0.020	0.026
	Sr-89 (Dry)	Non-detect	Not Analyzed	Not Analyzed
	+/- 2 Sigma			
	MDA	0.482		
	Sr-90 (Dry)	Non-detect	Not Analyzed	Not Analyzed
	+/- 2 Sigma			
	MDA	0.123		

Sample Location		Beaver Dam Creek	Beaver Dam Creek	Beaver Dam Creek	Beaver Dam Creek
Sample Station		SV-2013	SV-2013	SV-2013	SV-2013
Sample Date		5/6/2004	5/6/2004	5/6/2004	5/6/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish	Catfish
	Tritium (pCi/L)	<193	Not Analyzed	282	Not Analyzed
	+/- 2 Sigma			93	
Radionuclides (pCi/g)	Cs-137 (fresh)	0.076	0.044	Non-detect	Non-detect
	+/- 2 Sigma	0.024	0.021		
	MDA	0.024	0.020	0.023	0.019
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.211		0.235
	Sr-90 (Dry)	Not Analyzed	0.113	Not Analyzed	0.141
	+/- 2 Sigma		0.06		0.06
	MDA		0.100		0.104

Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Fourmile Creek	Fourmile Creek	Fourmile Creek	Fourmile Creek
Sample Station		SV-2015	SV-2015	SV-2015	SV-2015
Sample Date		5/6/2004	5/6/2004	5/6/2004	5/6/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish	Catfish
	Tritium (pCi/L)	2865	Not Analyzed	3761	Not Analyzed
	+/- 2 Sigma	167		186	
Radionuclides	Cs-137 (fresh)	0.086	0.058	0.316	0.167
(pCi/g)	+/- 2 Sigma	0.027	0.027	0.058	0.035
	MDA	0.024	0.024	0.020	0.018
	Sr-89 (Dry)	Not Analyzed	0.308	Not Analyzed	Non-detect
	+/- 2 Sigma		0.254		
	MDA		0.227		0.487
	Sr-90 (Dry)	Not Analyzed	0.208	Not Analyzed	Non-detect
	+/- 2 Sigma		0.076		
	MDA		0.094		0.144

Sample Location		Steel Creek	Steel Creek	Steel Creek
Sample Station		SV-2017	SV-2017	SV-2017
Sample Date		3/22/2004	3/22/2004	6/1/2004
Sample Cut		Edible	Non-edible	Edible
Species		Bass	Bass	Catfish
	Tritium (pCi/L)	3442	Not Analyzed	295
	+/- 2 Sigma	181		94
Radionuclides	Cs-137 (fresh)	0.225	0.171	0.071
(pCi/g)	+/- 2 Sigma	0.038	0.029	0.032
	MDA	0.022	0.019	0.020
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed
	+/- 2 Sigma			
	MDA		0.412	
	Sr-90 (Dry)	Not Analyzed	0.212	Not Analyzed
	+/- 2 Sigma		0.08	
	MDA		0.099	

Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Steel Creek	Steel Creek	Steel Creek
Sample Station		SV-2017	SV-2017	SV-2017
Sample Date		6/1/2004	6/1/2004	6/1/2004
Sample Cut		Non-edible	Edible	Non-edible
Species		Catfish	American shad	American shad
	Tritium (pCi/L)	Not Analyzed	285	Not Analyzed
	+/- 2 Sigma		93	
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma			
	MDA	0.019	0.021	0.020
	Sr-89 (Dry)	Non-detect	Not Analyzed	Not Analyzed
	+/- 2 Sigma			
	MDA	0.419		
	Sr-90 (Dry)	Non-detect	Not Analyzed	Not Analyzed
	+/- 2 Sigma			
	MDA	0.145		

Sample Location		Lower Three Runs	Lower Three Runs	Lower Three Runs	Lower Three Runs
Sample Station		SV-2020	SV-2020	SV-2020	SV-2020
Sample Date		5/14/2004	5/14/2004	5/14/2004	5/14/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish	Catfish
	Tritium (pCi/L)	526	Not Analyzed	315	Not Analyzed
	+/- 2 Sigma	102		94	
Radionuclides (pCi/g)	Cs-137 (fresh)	0.566	0.284	0.111	0.205
	+/- 2 Sigma	0.090	0.051	0.029	0.046
	MDA	0.023	0.022	0.022	0.040
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.537		0.538
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.145		0.123

Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Hwy. 301	Hwy. 301	Hwy. 301
Sample Station		SV-118	SV-118	SV-118
Sample Date		4/16/2004	4/16/2004	4/16/2004
Sample Cut		Edible	Non-edible	Edible
Species		Bass	Bass	Catfish
	Tritium (pCi/L)	2425	Not Analyzed	2042
	+/- 2 Sigma	158		149
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma			
	MDA	0.023	0.019	0.022
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed
	+/- 2 Sigma			
	MDA		0.352	
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed
	+/- 2 Sigma			
	MDA		0.114	

Sample Location		Hwy. 301	Hwy. 301	Hwy. 301
Sample Station		SV-118	SV-118	SV-118
Sample Date		4/16/2004	4/16/2004	4/16/2004
Sample Cut		Non-edible	Edible	Non-edible
Species		Catfish	Striped mullet	Striped mullet
	Tritium (pCi/L)	Not Analyzed	1953	Not Analyzed
	+/- 2 Sigma		146	
Radionuclides (pCi/g)	Cs-137 (fresh)	Non-detect	Non-detect	Non-detect
	+/- 2 Sigma			
	MDA	0.022	0.020	0.027
	Sr-89 (Dry)	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma			
	MDA	0.294		0.392
	Sr-90 (Dry)	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma			
	MDA	0.095		0.153

Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
Radionuclides Data

Sample Location		Stokes Bluff	Stokes Bluff	Stokes Bluff	Stokes Bluff
Sample Station		SV-355	SV-355	SV-355	SV-355
Sample Date		5/27/2004	5/27/2004	5/27/2004	5/27/2004
Sample Cut		Edible	Non-edible	Edible	Non-edible
Species		Bass	Bass	Catfish	Catfish
	Tritium (pCi/L)	227	Not Analyzed	228	Not Analyzed
	+/- 2 Sigma	91		91	
Radionuclides	Cs-137 (fresh)	0.056	Non-detect	Non-detect	Non-detect
(pCi/g)	+/- 2 Sigma	0.023			
	MDA	0.019	0.019	0.020	0.019
	Sr-89 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		1.03		0.365
	Sr-90 (Dry)	Not Analyzed	Non-detect	Not Analyzed	Non-detect
	+/- 2 Sigma				
	MDA		0.305		0.102

Sample Location		FMC-Individual	FMC-Individual
Sample Station		SV-2015	SV-2015
Sample Date		5/6/2004	5/6/2004
Sample Cut		Edible	Non-edible
Species		Bass	Bass
	Tritium (pCi/L)	<193	Not Analyzed
	+/- 2 Sigma		
Radionuclides	Cs-137 (fresh)	0.046	Non-detect
(pCi/g)	+/- 2 Sigma	0.020	
	MDA	0.023	0.020
	Sr-89 (Dry)	Not Analyzed	Non-detect
	+/- 2 Sigma		
	MDA		0.137
	Sr-90 (Dry)	Not Analyzed	Non-detect
	+/- 2 Sigma		
	MDA		0.132

Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

Radiological Monitoring of Fish Data
ESOP Historical Data, 2000-2004

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible
	Species		Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass
2004	Radionuclide	Tritium (pCi/L)	ND	ND	ND	ND	2865	3442	526	2425	227
2003			ND	ND	292	292	2621	888	666	705	508
2002			ND	**332**	**524**	**718**	6,801	1,637	ND	**763**	1,348
2001			ND	ND	2,462	562	525	1,768	530	1,148	858
2000			ND	ND	306	ND	16,031	2,353	355	490	597
2004	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	0.06	0.08	0.09	0.23	0.57	ND	0.06
2003			ND	0.05	0.04	0.05	0.37	0.15	0.06	0.07	0.06
2002			ND	0.04	0.05	0.16	0.22	0.26	0.72	0.06	0.06
2001			ND	0.10	0.10	0.23	0.08	0.82	0.08	0.05	0.05
2000			ND	0.05	0.87	0.09	0.41	0.16	0.08	0.08	0.07

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible
	Species		Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass
2004	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	ND	0.04	0.06	0.17	0.28	ND	ND
2003			ND	ND	ND	0.03	0.16	0.11	0.03	ND	ND
2002			ND	ND	0.04	0.06	0.15	0.13	0.40	ND	ND
2001			ND	0.04	0.04	0.11	0.04	0.39	0.05	0.02	0.03
2000			ND	0.03	0.35	0.03	0.17	0.09	0.04	0.03	0.03
2004	Radionuclide	Sr-90 (pCi/g **DRY**)	ND	ND	ND	0.11	0.21	0.21	ND	ND	ND
2003			NA	0.15	0.08	0.16	1.52	0.08	0.20	ND	0.31
2002			NA	NA	ND	0.42	1.37	NA	ND	ND	NA
2001			NA	NA	0.76	1.31	0.48	0.87	ND	ND	0.46
2000			NA	NA	0.50	NA	0.89	1.15	0.17	0.91	NA

Notes: - Non-Detect
- Not Analyzed

Bold denotes failed laboratory QA

Radiological Monitoring of Fish Data
ESOP Historical Data, 2000-2004

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible
	Species		Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish
2004	Radionuclide	Tritium (pCi/L)	ND	ND	377	282	3761	295	315	2042	228
2003			ND	209	ND	277	388	583	537	ND	354
2002			ND	ND	ND	271	931	890	ND	1150	621
2001			ND	ND	ND	ND	810	360	530	1104	736
2000			ND	ND	ND	ND	2858	975	500	590	685
2004	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	ND	ND	0.32	0.07	0.11	ND	ND
2003			ND	ND	ND	0.04	0.05	0.11	0.09	0.04	ND
2002			ND	0.03	0.09	ND	0.04	0.04	0.20	0.05	0.04
2001			ND	0.03	0.03	0.04	0.04	0.11	0.18	0.04	0.09
2000			ND	0.03	0.03	0.04	0.15	0.16	0.57	0.04	0.03

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible
	Species		Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish
2004	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	ND	ND	0.17	ND	0.21	ND	ND
2003			ND	ND	ND	ND	0.05	0.09	0.05	ND	ND
2002			ND	ND	ND	ND	ND	ND	0.08	ND	ND
2001			ND	0.01	0.02	0.01	0.02	0.04	0.12	0.02	0.03
2000			ND	0.01	0.02	ND	0.08	0.08	0.29	0.02	0.02
2004	Radionuclide	Sr-90 (pCi/g **DRY**)	NA	ND	ND	0.14	ND	ND	ND	ND	ND
2003			NA	0.26	0.11	0.20	0.26	ND	0.09	ND	ND
2002			NA	NA	ND	ND	ND	ND	ND	ND	NA
2001			NA	0.33	0.31	0.33	0.59	0.66	0.49	ND	1.73
2000			NA	NA	0.274	0.16	0.30	1.12	ND	0.11	NA

Notes: ND - Non-Detect
ND - Not Analyzed

Bold denotes failed laboratory QA

Radiological Monitoring of Fish Data
ESOP and DOE-SR Data Comparison

Table 1
Tritium Activity Levels in Edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< LLD
	SRS	3	<MDC
UTR	SCDHEC	1	<LLD
	SRS	3	<MDC
BDC	SCDHEC	1	<LLD
	SRS	3	0.22
FMC	SCDHEC	1	2.29
	SRS	3	0.49
STC	SCDHEC	1	2.75
	SRS	3	<MDC
LTR	SCDHEC	1	0.42
	SRS	3	<MDC
Hwy. 301	SCDHEC	1	1.94
	SRS	3	0.37
Average	SCDHEC	4	1.85
	SRS	9	0.36
Standard Deviation	SCDHEC	4	1.01
	SRS	9	0.14

Table 2
Tritium Activity Levels in Edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	<LLD
	SRS	3	<MDC
UTR	SCDHEC	1	0.30
	SRS	3	<MDC
BDC	SCDHEC	1	0.23
	SRS	3	<MDC
FMC	SCDHEC	1	3.01
	SRS	3	0.10
STC	SCDHEC	1	0.24
	SRS	3	<MDC
LTR	SCDHEC	1	0.25
	SRS	3	<MDC
Hwy. 301	SCDHEC	1	1.63
	SRS	3	0.28
Average	SCDHEC	6	0.94
	SRS	6	0.19
Standard Deviation	SCDHEC	6	1.32
	SRS	6	0.12

Table 3
Cesium-137 Activity Levels in Edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	<MDA
	SRS	3	0.03**
UTR	SCDHEC	1	0.06
	SRS	3	0.07*
BDC	SCDHEC	1	0.08
	SRS	3	0.11
FMC	SCDHEC	1	0.09
	SRS	3	0.99
STC	SCDHEC	1	0.23
	SRS	2	0.16
LTR	SCDHEC	1	0.57
	SRS	3	0.13
Hwy. 301	SCDHEC	1	<MDA
	SRS	3	0.04
STOKES	SCDHEC	1	0.06
	SRS	3	<MDC
Average	SCDHEC	6	0.18
	SRS	17	0.25
Standard Deviation	SCDHEC	6	0.20
	SRS	17	0.36

Table 4
Cesium-137 Activity Levels in Edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	0.03**
UTR	SCDHEC	1	< MDA
	SRS	3	<MDC
BDC	SCDHEC	1	<MDA
	SRS	3	<MDC
FMC	SCDHEC	1	0.32
	SRS	3	0.01**
STC	SCDHEC	1	0.07
	SRS	3	0.05**
LTR	SCDHEC	1	0.11
	SRS	3	0.08
Hwy. 301	SCDHEC	1	<MDA
	SRS	3	0.03
STOKES	SCDHEC	1	< MDA
	SRS	3	<MDC
Average	SCDHEC	3	0.17
	SRS	9	0.06
Standard Deviation	SCDHEC	3	0.13
	SRS	9	0.02

Notes:
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Four Mile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Savannah River at U.S. Hwy. 301
STOKES = Stokes Bluff

MDA = Minimum Detectable Activity
MDC = Minimum Detectable Concentration
SRS data from WSRC 2005
SRS results are averages
* includes one result below MDC
** includes two results below MDC
Averages calculated using detections only

Radiological Monitoring of Fish Data
ESOP and DOE-SR Data Comparison

Table 5
Cesium-137 Activity Levels in Non-edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	<MDC
UTR	SCDHEC	1	< MDA
	SRS	3	0.04**
BDC	SCDHEC	1	0.04
	SRS	3	0.06*
FMC	SCDHEC	1	0.06
	SRS	3	0.82
STC	SCDHEC	1	0.17
	SRS	3	0.22
LTR	SCDHEC	1	0.28
	SRS	3	<MDC
Hwy. 301	SCDHEC	1	< MDA
	SRS	3	0.02**
Average	SCDHEC	4	0.14
	SRS	10	0.33
Standard Deviation	SCDHEC	4	0.11
	SRS	10	0.35

Table 6
Cesium-137 Activity Levels in Non-edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	<MDC
UTR	SCDHEC	1	< MDA
	SRS	3	< MDC
BDC	SCDHEC	1	<MDA
	SRS	3	0.04**
FMC	SCDHEC	1	0.17
	SRS	3	<MDC
STC	SCDHEC	1	<MDA
	SRS	3	0.03**
LTR	SCDHEC	1	0.21
	SRS	3	0.05*
Hwy. 301	SCDHEC	1	< MDA
	SRS	3	0.01**
Average	SCDHEC	2	0.19
	SRS	5	0.05
Standard Deviation	SCDHEC	2	0.03
	SRS	5	0.02

Table 7
Strontium-89,90 Activity Levels in Non-edible Bass
pCi/g (DRY)

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	0.16
	SRS	3	0.09
UTR	SCDHEC	1	0.12
	SRS	3	0.10
BDC	SCDHEC	1	0.10
	SRS	3	0.16
FMC	SCDHEC	1	0.25
	SRS	3	0.76
STC	SCDHEC	1	0.17
	SRS	3	0.12
LTR	SCDHEC	1	0.09
	SRS	3	0.07**
Hwy. 301	SCDHEC	1	0.08
	SRS	3	<MDC
Average	SCDHEC	7	0.14
	SRS	16	0.24
Standard Deviation	SCDHEC	7	0.06
	SRS	16	0.27

Table 8
Strontium-89,90 Activity Levels in Non-edible Catfish
pCi/g (DRY)

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	0.07
	SRS	3	0.08*
UTR	SCDHEC	1	0.08
	SRS	3	0.09
BDC	SCDHEC	1	0.13
	SRS	3	0.14
FMC	SCDHEC	1	0.13
	SRS	3	0.09
STC	SCDHEC	1	<MDC
	SRS	3	0.08*
LTR	SCDHEC	1	<MDC
	SRS	3	0.08
Hwy. 301	SCDHEC	1	0.08
	SRS	3	0.09*
Average	SCDHEC	5	0.10
	SRS	18	0.10
Standard Deviation	SCDHEC	5	0.03
	SRS	18	0.02

Notes:
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Four Mile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Savannah River at U.S. Hwy. 301

MDA = Minimum Detectable Activity
MDC = Minimum Detectable Concentration
SRS data from WSRC 2005
SRS results are averages
* includes one result below MDC
** includes two results below MDC
Averages calculated using detections only

4.1.5 Summary Statistics
Radiological Monitoring of Fish

Tritium levels (pCi/L) in Savannah River Fish, 2004

Species	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	6 (4)	1897	1438	2425	526	3442
Catfish	7 (2)	1043	1364	315	228	3761
Striped mullet	2 (1)	1450	711		947	1953
American shad	1 (1)					285

Non-detects ( ) excluded from computations

Cs-137 levels (pCi/g) in Savannah River Fish, 2004

Species	Composite Type	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	Edible	6 (3)	0.178	0.200	0.081	0.056	0.566
	Nonedible	4 (5)	0.139	0.112	0.115	0.044	0.284
Catfish	Edible	3 (6)	0.166	0.131	0.111	0.071	0.316
	Nonedible	2 (7)	0.186	0.027	0.186	0.167	0.205
Striped mullet	Edible	(3)					
	Nonedible	(3)					
American shad	Edible	(2)					
	Nonedible	(2)					

Non-detects ( ) excluded from computations

Sr-90 levels (pCi/g - Dry) in Savannah River Fish, 2004

Species	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	3 (6)	0.178	0.056	0.208	0.113	0.212
Catfish	1 (8)					0.141
Striped mullet	(3)					
American shad	(2)					

Non-detects ( ) excluded from computations

N - denotes number of samples
Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

4.2 Radiological Game Animal Monitoring Adjacent to SRS

4.2.1 Summary

White-tailed deer and feral hogs have access to a number of contaminated areas on the Savannah River Site (SRS), and consequently are a vector for the redistribution of contaminants, including cesium-137 (Cs-137), to off-site locations. Consumption of these wildlife species can result in the transfer of contaminants to humans. The radionuclide of concern is Cs-137 because of its relatively long physical half-life of 30 years, and its availability to game animals and associated health risk to humans.

The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) conducts independent non-regulatory oversight of game animal monitoring activities at the SRS. The game animal project addresses concerns of potentially contaminated white-tailed deer and feral hogs migrating off the SRS by analyzing samples collected off-site. In 2004 ESOP analyzed muscle tissue for Cs-137 from 50 deer from within a five-mile study area adjacent to the SRS.

RESULTS AND DISCUSSION

A total of 65 deer samples were collected. Fifty samples were collected within five miles of the SRS perimeter (Map 12, section 4.2.2). Fifteen deer background samples were collected 120 miles northeast of the SRS. ESOP compared total Cs-137 activities to DOE-SR results. All analytical results are given in section 4.2.4 and all summary statistics are given in section 4.2.5.

<u>Cs-137 Activity</u>

Cs-137 and the naturally occurring K-40 were the only isotopes detected in game samples collected in 2004. Cs-137 is readily incorporated into the human body because of its similarity to K-40 in physiological processes (Davis 1963). The Cs-137 concentrates in animal skeletal muscles, which are selectively consumed by hunters (Brisbin 1975). Cs-137 is an important radionuclide because of its relatively long physical half-life of 30 years and its associated health risks (Haselow 1991). Cs-137 emits both beta and gamma radiation, contributing to both internal and external radiation exposure, which may be associated with gastrointestinal, genetic, hemopoietic, and central nervous system damage (Bond 1965). Because of these concerns, Cs-137 will be the only isotope discussed in this report.

Cs-137 activities from the 50 white-tailed deer perimeter samples ranged from 0.07 to 4.56 picocuries per gram (pCi/g), with an average of 1.60 pCi/g. Sample results from the fifteen deer collected 120 miles northeast of the SRS ranged from 0.34 pCi/g to 2.44 pCi/g, with an average of 1.16 pCi/g. WSRC reported an approximate field measurement range of 1.0 pCi/g to 48.3 pCi/g, with an average of 1.16 pCi/g, from 817 deer harvested on the SRS in 2004 (WSRC 2005). ESOP mean values were calculated by using analytical lab data at or above the Minimum Detectable Activity (MDA). Average Cs-137 concentrations are given in Figure 1. section 4.2.3.

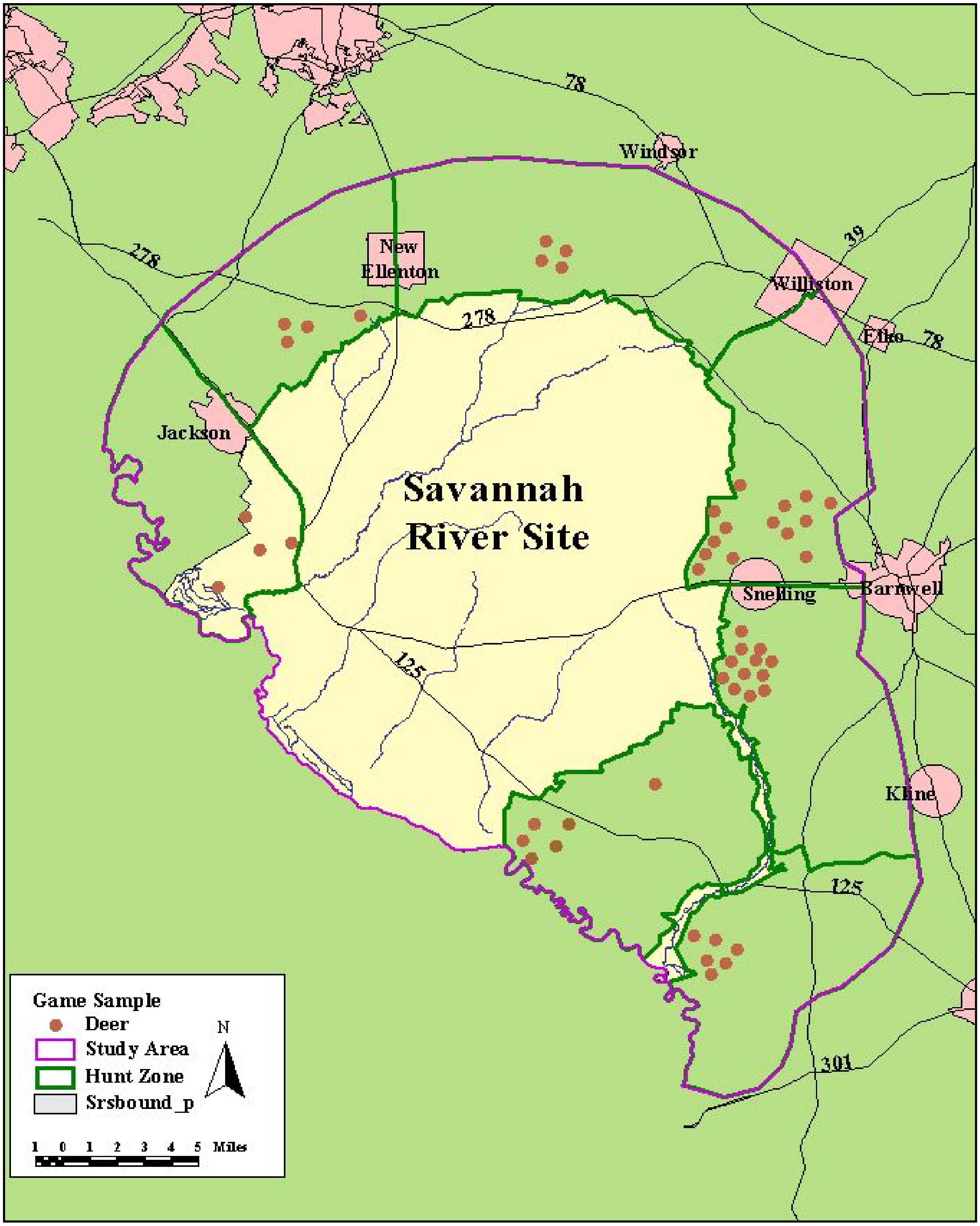
CONCLUSIONS/RECOMMENDATIONS

In 2004, muscle tissue from 50 animals within a five-mile study area adjacent to SRS was analyzed for gamma-emitting radionuclides. Fifteen deer tissue samples were also collected and analyzed from a background area 120 miles northeast of the SRS. The study area Cs-137 area results (1.60 pCi/g +/- 1.10 pCi/g) are within one standard deviation of the ESOP background result (1.16 pCi/g +/- 0.62 pCi/g). The 2000 to 2004 DOE-SR estimated off-site Cs-137 activity in deer average (2.00 +/- 1.24 pCi/g) was approximately within one standard deviation of the ESOP detected average (1.506 +/- 0.435 pCi/g). Although Cs-137 was deposited on the SRS from site operations, levels found in the study and background locations are likely results of global aboveground nuclear weapons testing (Jannik 1997). WSRC does not collect game animal samples within the SCDHEC study area and off-site hunter doses are based on DOE-SR models; therefore, no direct comparisons could be made between ESOP and DOE-SR data.

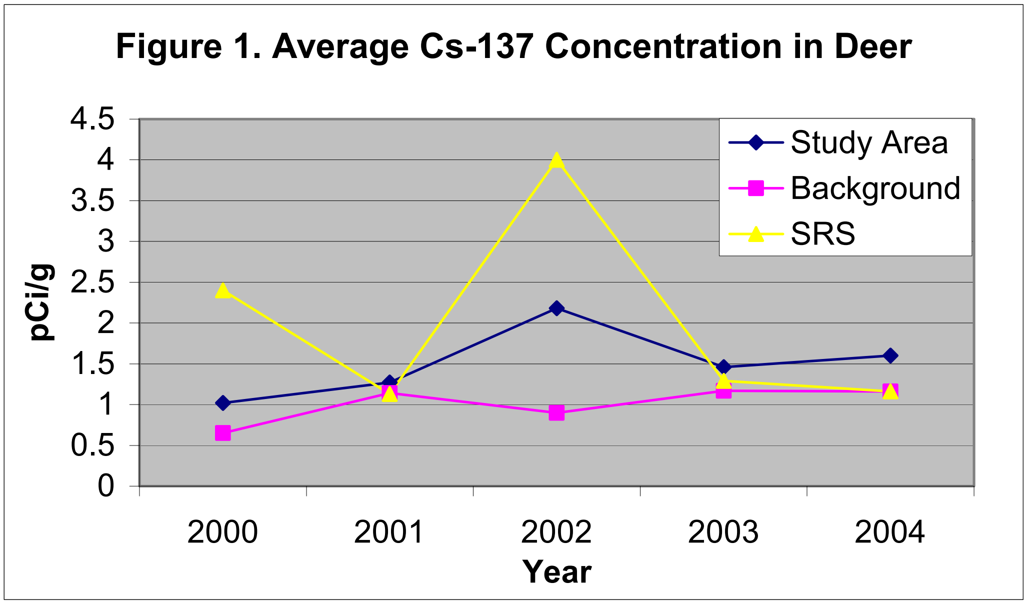
During this study, slightly elevated Cs-137 (defined as > 1 pCi/g) concentrations were noticed in all seven-study area zones. Age, sex, body weight, soil type and location of collection may affect the Cs-137 activities found in white-tailed deer and hogs. A portion of the elevated Cs-137 activity found in deer harvested in hunt units five and seven may be attributed to historic SRS operations. These operations released known Cs-137 contamination to Steel Creek and Lower Three Runs, their floodplains, and the Savannah River swamp, all of which impact hunt zones five and seven. Further research may be needed to help determine why elevated Cs-137 activities are found in other hunt units.

The precise ranging behavior of individual deer and hogs on the SRS is unknown. Deer and hogs have access to contaminated areas on-site and it is possible that some animals migrate off-site where they can be harvested by local hunters. Sampling by ESOP of deer and hogs harvested off-site can provide valuable information concerning the potential off-site exposure to Cs-137.

4.2.2
Map 12. Radiological Game Animal Monitoring Adjacent to SRS



4.2.3 Tables and Figures
Radiological Game Animal Monitoring



4.2.4 Data
Radiological Game Animal Monitoring Adjacent to SRS Data

Radiological Game Monitoring
Background Data

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2004	12/22/2004	12/22/2004	12/22/2004	12/22/2004
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Buck	Doe	Doe
Weight	Pounds	105	105	75	55	50
Cesium-137	(pCi/g) wet	0.53	0.39	0.99	0.92	0.80
Uncertainty	(+/- 2sig)	0.07	0.06	0.11	0.11	0.09
MDA	(pCi/g) wet	0.02	0.02	0.02	0.03	0.03

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2004	12/22/2004	12/22/2004	12/22/2004	12/22/2004
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Buck	Doe	Doe
Weight	Pounds	85	70	90	110	100
Cesium-137	(pCi/g) wet	0.34	1.18	2.44	1.20	1.44
Uncertainty	(+/- 2sig)	0.05	0.14	0.25	0.13	0.15
MDA	(pCi/g) wet	0.02	0.03	0.02	0.02	0.02

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2004	12/22/2004	12/22/2004	12/22/2004	12/22/2004
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Buck	Doe	Buck
Weight	Pounds	100	85	115	95	80
Cesium-137	(pCi/g) wet	1.96	1.29	1.68	1.81	0.38
Uncertainty	(+/- 2sig)	0.02	0.14	0.18	0.19	0.05
MDA	(pCi/g) wet	0.03	0.02	0.03	0.03	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Game Monitoring
Game Animal Monitoring Data

Sample Location		Zone-1	Zone-1	Zone-1	Zone-1
Sample Date		10/15/2004	10/22/2004	12/4/2004	12/4/2004
Species		Deer	Deer	Deer	Deer
Sex		Buck	Buck	Doe	Doe
Weight	Pounds	110	160	120	70
Cesium-137	(pCi/g) wet	0.61	2.73	3.87	1.88
Uncertainty	(+/- 2sig)	0.09	0.39	0.54	0.27
MDA	(pCi/g) wet	0.02	0.03	0.02	0.02

Sample Location		Zone-2	Zone-2	Zone-2	Zone-2
Sample Date		9/18/2004	6/20/2004	10/24/2004	11/10/2004
Species		Deer	Deer	Deer	Deer
Sex		Doe	Buck	Doe	Doe
Weight	Pounds	100	140	110	120
Cesium-137	(pCi/g) wet	0.33	2.07	0.51	3.63
Uncertainty	(+/- 2sig)	0.06	0.30	0.09	0.36
MDA	(pCi/g) wet	0.02	0.02	0.03	0.02

Sample Location		Zone-3	Zone-3	Zone-3	Zone-3
Sample Date		8/28/2004	8/28/2004	10/24/2004	11/24/2004
Species		Deer	Deer	Deer	Deer
Sex		Buck	Buck	Doe	Doe
Weight	Pounds	180	170	125	65
Cesium-137	(pCi/g) wet	0.31	0.32	1.87	3.02
Uncertainty	(+/- 2sig)	0.06	0.06	0.27	0.43
MDA	(pCi/g) wet	0.03	0.03	0.03	0.03

Notes:
MDA - Minimum Detectable Activity

Radiological Game Monitoring
Game Animal Monitoring Data

Sample Location		Zone-4	Zone-4	Zone-4	Zone-4	Zone-4	Zone-4
Sample Date		9/7/2004	9/15/2004	9/15/2004	9/18/2004	9/20/2004	9/21/2004
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Buck	Doe	Buck	Doe	Buck	Doe
Weight	Pounds	170	85	160	130	135	105
Cesium-137	(pCi/g) wet	1.77	0.73	1.09	1.23	1.87	1.30
Uncertainty	(+/- 2sig)	0.25	0.11	0.16	0.17	0.27	0.19
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.02	0.02

Sample Location		Zone-4	Zone-4	Zone-4	Zone-4	Zone-4	Zone-4
Sample Date		9/23/2004	9/27/2004	9/29/2004	10/15/2004	11/29/2004	12/2/2004
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Buck	Doe	Doe	Buck
Weight	Pounds	105	110	125	115	65	165
Cesium-137	(pCi/g) wet	1.42	1.90	2.90	2.59	1.53	4.56
Uncertainty	(+/- 2sig)	0.21	0.27	0.29	0.36	0.22	0.64
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.02	0.03

Sample Location		Zone-4	Zone-4
Sample Date		12/2/2004	12/12/2004
Species		Deer	Deer
Sex		Doe	Buck
Weight	Pounds	145	155
Cesium-137	(pCi/g) wet	4.22	2.03
Uncertainty	(+/- 2sig)	0.59	0.21
MDA	(pCi/g) wet	0.03	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Game Monitoring
Game Animal Monitoring Data

Sample Location		Zone-5	Zone-5	Zone-5	Zone-5	Zone-5	Zone-5
Sample Date		10/2/2004	10/8/2004	10/15/2004	10/15/2004	10/15/2004	10/15/2004
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Doe	Doe	Doe	Doe
Weight	Pounds	85	130	95	90	100	100
Cesium-137	(pCi/g) wet	1.76	0.95	1.36	0.76	1.41	2.90
Uncertainty	(+/- 2sig)	0.25	0.14	0.20	0.12	0.20	0.41
MDA	(pCi/g) wet	0.02	0.03	0.02	0.02	0.02	0.02

Sample Location		Zone-5	Zone-5	Zone-5	Zone-5	Zone-5	Zone-5
Sample Date		10/21/2004	10/26/2004	10/26/2004	10/31/2004	11/11/2004	11/20/2004
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Buck	Buck	Doe	Doe
Weight	Pounds	115	120	125	170	55	50
Cesium-137	(pCi/g) wet	1.09	1.32	2.18	2.54	3.58	0.95
Uncertainty	(+/- 2sig)	0.16	0.19	0.31	0.36	0.50	0.14
MDA	(pCi/g) wet	0.03	0.03	0.02	0.02	0.03	0.02

Sample Location		Zone-6	Zone-6	Zone-6	Zone-6	Zone-6
Sample Date		11/26/2004	11/26/2004	11/26/2004	11/26/2004	11/26/2004
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Buck	Doe	Doe
Weight	Pounds	130	150	100	120	115
Cesium-137	(pCi/g) wet	0.74	0.88	1.08	0.99	1.14
Uncertainty	(+/- 2sig)	0.12	0.13	0.16	0.15	0.17
MDA	(pCi/g) wet	0.03	0.03	0.03	0.02	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Game Monitoring
Game Animal Monitoring Data

Sample Location		Zone-6	Zone-6
Sample Date		11/26/2004	11/26/2004
Species		Deer	Deer
Sex		Doe	Buck
Weight	Pounds	120	120
Cesium-137	(pCi/g) wet	0.78	0.99
Uncertainty	(+/- 2sig)	0.12	0.15
MDA	(pCi/g) wet	0.02	0.02

Sample Location		Zone-7	Zone-7	Zone-7	Zone-7	Zone-7
Sample Date		8/15/2004	11/4/2004	11/12/2004	12/3/2004	12/3/2004
Species		Deer	Deer	Deer	Deer	Deer
Sex		Buck	Buck	Doe	Doe	Doe
Weight	Pounds	155	168	90	90	110
Cesium-137	(pCi/g) wet	0.07	0.72	0.40	0.46	0.43
Uncertainty	(+/- 2sig)	0.03	0.11	0.07	0.06	0.06
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.02

Notes:
MDA - Minimum Detectable Activity

4.2.5 Summary Statistics
Radiological Game Monitoring
Cesium-137

	N	Average	Std.Dev.	Median	Min.	Max.
Study Area	50	1.60	1.10	1.31	0.07	4.56
Background	15	1.16	0.63	1.16	0.34	2.44

Notes:
N - Number of Samples
Std.Dev. - Standard Deviation
Min - Minimum
Max - Maximum

5.1 2004 Critical Pathway

5.1.1 Summary

The Department of Energy Savannah River (DOE-SR) operates the government facility located in South Carolina that produced nuclear materials for the national defense during the cold war era. Throughout it's operational history there have been documented instances of radiological materials that were released to the environment during production activities. A critical pathway assessment of the Savannah River Site (SRS) was performed that included a review of DOE documented instances of radiological materials released to the environment during the site's history in addition to recent data from DOE-SR and the South Carolina Department of Health and Environmental Control (SCDHEC). Added emphasis was placed on releases that occurred during the past eight years (1993-2000) and on more recent dose estimates to the Maximum Exposed Individual (MEI) up to the end of 2004. The SCDHEC survivalist-sportsman scenario dose projections were compared to the phase III "Draft for Public Comment" SRS Dose Reconstruction scenario projections by the United States Center for Disease Control (CDC 2004). From these document reviews and recent data, the primary radiological contaminants released by the SRS and the exposure pathways leading from the SRS to the surrounding public have been identified. This assessment only considered radiological contaminants even though there is nonradiological contamination on the SRS. Nonradiological releases will be evaluated by SCDHEC in future updates of the critical pathway review.

The potential for high dose releases of toxic and radiological contaminants to the environment still exists. Appropriate early warning monitoring should minimize the risk to the public and the environment from accidental releases of hazardous substances.

RESULTS AND DISCUSSIONS

PRIMARY RADIOLOGICAL CONTAMINANTS

The primary atmospheric contaminants were identified using the Radiological Assessments Corporation (RAC) Report, SRS Environmental Reports, and Environmental Surveillance and Oversight Program (ESOP) Project Reports (Table 1, section 5.1.2). The RAC Report documented the major activities and releases from the beginning of SRS operations through 1992 by reviewing SRS environmental data, point discharge releases and information that was considered classified until recently. Because the RAC report data collection ended in 1992, the SRS Environmental Data Reports were used from 1993 to present date to close the data gap.

In evaluating the information published in the RAC report several issues became apparent. First, SRS atmospheric and liquid discharges had decreased dramatically by the time all five reactors were closed in 1988. Second, several of the radiological contaminants released during the operational history of the site had short half lives and were no longer significant in terms of human exposure. Therefore, this report only used SRS Environmental Data Reports from 1993 through 2004 to represent major radionuclides that had been released or were still being released. As a result, only radionuclides that would contribute at least 1 percent (considered conservative for this project) or more to the total dose for the maximally exposed individual (MEI) were considered. The MEI is simply a hypothetical person who remains in an uncontrolled area around the perimeter of the SRS that would receive the greatest possible dose equivalent from all potential pathways of the SRS operations (WSRC 2001).

The ESOP Project Reports were used as an independent source of data for environmental samples collected on and adjacent to the SRS to help verify findings from the RAC and SRS Environmental Data Reports.

Atmospheric Contaminants

The RAC Report presents a list of radionuclides and corresponding screening values for all pathways for those living near the SRS based on the method used by the National Council on Radiation Protection and Measurements (NCRP). This method considers factors such as environmental transport mechanisms, exposure pathways and radiation dosimetry. The first step in the screening method identified I-131 and tritium to be the major contributors of atmospheric contamination. Other radionuclides identified are shown in Table 1, section 5.1.2. A second step in the screening method revealed I-129, I-131, tritium, argon-41 (Ar-41), and Pu- 239,240 ranking among the top of the contribution list for at least two of the seven exposure pathways (RAC 1999).

The diffuse and fugitive atmospheric releases reported in the SRS Environmental Reports list all of the radionuclides that were released from unmonitored sources such as ponds and contaminated land areas (section 5.1.3). Of the many radionuclides listed, the following appear most consistently: tritium, C-14, Co-60, nickel-63 (Ni-63), Sr-89,90, Zr-95, Ru-106, antimony-125 (Sb-125), Cs-134, Cs-137, Ce-144, Eu-154, Eu-155, Pu-238, Pu-239, Am-241, and Cm-244. Another source of data, the Potential Radiation Doses section of the SRS Environmental Data Reports, were also used to help identify primary atmospheric contaminants. Only radionuclides from atmospheric releases between 1993 and 2004, that made up greater than or equal to 1 percent of the total dose to the MEI, were considered (section 5.1.3). A list of these radionuclides is also shown in section Table 1, 5.1.2. The radionuclides that consistently contribute more than 1 percent of the total dose to the MEI are tritium, I-129, Cs-137, Pu-238, and Pu-239.

The 1999 Radiological Atmospheric Monitoring Project and 1998 Terrestrial Vegetation Radiological Monitoring Project Reports were also reviewed to identify which radionuclides were consistently being detected in atmospheric samples on and adjacent to the SRS. The radionuclides listed in Table 2 are typically found in air and vegetation samples (SCDHEC 2000). Tritium in stream water and carbon-14 in air stack releases by SRS are observed and used to verify calculated release data (WSRC 1998). Cesium-137 was observed in ESOP 2003 edible vegetation.

Nearly all radionuclides listed in the RAC and SRS reports are calculated with mathematical transport models based on historical release information (RAC) or current release documents (SRS). Environmental data from DOE-SR and ESOP serve as verification for the calculated dose estimates to the public and the environment.

An evaluation of the data indicates that the current important radionuclides from a public health perspective are tritium, I-129, Cs-137, and plutonium isotopes. These radionuclides contributed greater than 1 percent of the total dose to the MEI from atmospheric releases from 1993 – 2004.

Tritium, I-129 and Pu-239 were also listed in the RAC Report as radionuclides that rank among the top contributors for at least two of the seven exposure pathways. Two other radionuclides listed in the RAC Report, I-131 and Ar-41, are no longer of concern due to their short half-lives.

Liquid Contaminants

The primary liquid contaminants are located in section Table 2, section 5.1.2.

The first screening step in the RAC Report identified sixteen radiological contaminants including Cs-137 and tritium that dominates all pathways. The second screening step further narrowed this list of contaminants to tritium, phosphorus-32 (P-32), sulfur-35 (S-35), Co-60, Zn-65, Tc-99, Sr-90, I-131, Cs-137, and uranium as radionuclides found in at least one surface water pathway (RAC 1999).

The radionuclides from liquid releases between 1993 and 2004 that made up greater than or equal to 1 percent of the total dose to the MEI are listed in section 5.1.3. These radionuclides are also shown on Table 2, section 5.1.2.

The radionuclides that were detected on a routine basis by the ESOP are listed in Table 2, section 5.1.2. These radionuclides were found in surface water, sediment and fish on and adjacent to the SRS (SCDHEC 2000).

An evaluation of the data indicates that the current important radionuclides from a public health perspective are tritium, Sr-90, I-129, Cs-137, and Pu-239. These radionuclides consistently contributed more than 1 percent of the total dose to the MEI (from 1993 – 2004). ESOP Project Reports verify the presence of tritium, Sr-90, I-129 and Cs-137 in the environment. The RAC Report also supports this by listing tritium, Sr-90, I-129, and Cs-137 in their second screening step. Other radionuclides listed in the RAC Report second screening step such as P-32, S-35, Co-60, Zn-65, I-131 are not considered significant due to their short half-lives. Tc-99 and uranium may become important radionuclides in the future because of their long half-lives

PRIMARY EXPOSURE PATHWAYS

The two main environmental pathways from the SRS to the surrounding public are atmospheric and liquid. The environmental mediums associated with atmospheric releases include air, soil, and food. The environmental mediums involved with liquid releases are food, surface water, and groundwater. These environmental mediums can create exposure pathways to the public. The atmospheric and resuspended soil contamination contributes to the inhalation, plume (atmospheric releases that can effect the public through dermal contact), and ground exposure pathways. The drinking water, swimming, boating and shoreline exposure pathways are created when surface water is used for drinking water and recreational purposes. The consumption of vegetation and cow milk, as well as fish and game animal (also known as the sportsman exposure pathway) pathways are created by the food medium.

Exposure routes connect the exposure pathways to the surrounding public. The three exposure routes include inhalation, dermal absorption, and ingestion. Inhalation includes breathing in atmospheric plumes, and resuspended soil and sediments. Dermal absorption and ingestion can occur through atmospheric and liquid plumes, swimming, boating and shoreline exposure pathways. Food and water environmental mediums lead to the surrounding public's ingestion exposure routes.

Data from the Potential Radiation Doses section of the SRS Environmental Data Reports for 1993 through 2004 were used to graph exposure pathway trends for both atmospheric and liquid releases. Data used for atmospheric releases were taken from the MAXDOSE-SR code – using the consumption of cow milk pathway. The data tables used to develop Figures 1–3, section 5.1.2 can be found in section 5.1.3.

Atmospheric Pathway

The dose to the MEI from atmospheric releases is shown in Figure 1, section 5.1.2. Since 1993, the inhalation and vegetation exposure pathways have been dominant during the last eight years. Other pathways that represent a smaller fraction of the atmospheric dose include cow milk, meat, ground and plume.

Air

The air medium consists of inhalation and plume exposure pathways. As shown in Figure 1, section 5.1.2, the plume exposure pathway has not exceeded one percent of the total dose to the MEI in the last eleven years. However, the inhalation exposure pathway has contributed more than 1 percent of the total dose. Tritium accounts for the majority of the total dose to the MEI from air releases since 1993 (section 5.1.3).

Soil

The soil medium includes the accumulation of radionuclides in the ground exposure pathway from atmospheric releases. This DOE-SR release did not appear to be a significant source of the overall MEI dose.

Food

Vegetation, cow milk and meat are classified as exposure pathways under the food medium. Vegetation contributes substantially to the total dose of the MEI (Figure 1, section 5.1.2). Tritium accounts for the majority of this dose from air releases (section 5.1.3).

In summary, the inhalation and vegetation exposure pathways are the most significant contributors from the atmospheric pathway. These two exposure pathways directly affect the inhalation and ingestion exposure routes of the surrounding public. Tritium is detected most often in the inhalation and vegetation exposure pathways.

Liquid Pathway

Figure 2 in Section 5.1.2 illustrates a graph of the potential dose to the MEI from liquid releases. Consumption of fish and water dominate the liquid environmental pathway.
Exposure pathways from shoreline, boating, and swimming contribute less than one percent of the total dose to the MEI; this data can also be found in section 5.1.3.

Food

Fish is a very dominant exposure pathway in the food environmental medium. This pathway has contributed a significant portion of the dose to the MEI during the last eleven years (Figure 2, section 5.1.2). Cs-137 and Sr-90 are the predominant radionuclides detected in fish (SCDHEC 2000).

Surface Water

The other portion of the dose from the liquid pathway was contributed by the surface water environmental medium. This dose to the MEI is caused by the tritium consumption of drinking water consumers downstream of the SRS. Boating and swimming are also considered part of this environmental medium, though only for dermal absorption and not for the ingestion exposure route. However, they essentially do not contribute to the total MEI dose.

Groundwater

Localized contaminated groundwater on the SRS outcrops into onsite streams that ultimately discharge into the Savannah River.

Sportsman Exposure Pathway

The sportsman exposure pathway is the dose to local hunters and fishermen. This exposure pathway has drawn a considerable amount of attention since 1993 (Figure 3, section 5.1.2) due to the differences in dose exposure noted between onsite and offsite hunters. The sportsman exposure pathway is influenced by the food and surface water environmental mediums (section 5.1.3).

A sportsman dose is presented in the Potential Radiation Doses section of the SRS Environmental Reports (section 5.1.3). Figure 3 in section 5.1.2 compares the MEI dose from all releases (atmospheric and liquid) to the sportsman dose. The MEI dose from all releases between the years 1993 - 2004 is not above 1.0-millirem (mrem). Conversely, the onsite hunter has consistently been above 15-mrem. The offsite hunter and offsite fisherman have the second and third highest dose to the MEI, respectively. All three of the sportsman doses are greater than all other exposure pathways combined. The dose to the sportsman exposure pathway is largely influenced by Cs-137 uptake in the SRS deer population. Other radionuclides such as Sr-90, Sr-89/90, Ra-226 and Ra-228 also exceed the SRS benchmark values for the onsite recreational hunter (WSRC 2000). These radionuclides bioaccumulate in deer harvested onsite, and are passed on to the local hunters. Deer harvested onsite are monitored by SRS personnel before the harvested animal leaves the SRS. SRS personnel also calculate the cumulative annual dose for each individual hunter for the animals they have harvested throughout the year.

Dose Reconstruction Reports

ESOP attended Citizen Advisory Board (CAB) meetings on a regular basis, and reviewed the information contained in the reports in order to assess the ESOP and SRS environmental programs.

The Phase III SRS "Draft for Public Comment" SRS Dose Reconstruction Report (CDC 2004) made important recommendations based on analysis of various scenarios for critical pathway assessments. This report attempted to address the public health consequences of SRS operations for a child born in 1955 and 1964 for the 39 year period since plant operations began.

The CDC designed the Dose Reconstruction project to take place in five phases. The project included input from open public participation, citizen advisory boards, and the SRS Health Effects Subcommittee (SRSHES). These committees reflect the diversity of the communities and make recommendations to SRS and the CDC. The SRSHES advised the CDC on the adequacy of their health research and public health activities associated with the SRS Dose Reconstruction Project.

Phase I (completed 1995) copied documents, established an electronic database, and described SRS areas and processes. Phase II (completed 2001) included source term development, and pathway analysis up to 1992 that resulted in a 1400 page report entitled, " Savannah River Site Environmental Dose Reconstruction Project, Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval, Evaluation of materials Released from the Savannah River Site (Phase II)".

In the Phase III "Draft for Public Comment", the CDC (2004 Draft) intended to use the International Atomic Energy Agency (IAEA) Safety Series Report No. 19 for a screening analysis of SRS. The idea was to determine what radiological releases might have biological significance and warrant further investigation in Phases III and IV. Phase III level 1 screening was for all pathways, and level 2 screening was for each individual pathway. The CDC revised their approach to include 7 hypothetical sets of individuals performing realistic and extreme activities on and near the SRS. The scenarios included families that lived and worked in the SRS area (<50 miles) while bearing children and engaging in radiation exposure activities during the years of SRS releases. The hunter-fisherman sportsman living in the swamps downriver was not a scenario addressed by the CDC study. However, the outdoors family and near river family studies incorporated some of the same elements (fish consumption). The ESOP and SRS environmental reports highlight the importance of external exposure during game animal harvesting, especially deer and hogs, and game animal consumption to the overall dose to the MEI.

The conclusions of the "Draft for Public Comment" (CDC 2004) phase III SRS Dose Reconstruction Report study are quoted as follows:

1. Doses and risks are small for all receptors and scenarios relative to doses and risks from background radiation over the 39-year period of the study.
2. For people who ate fish from the Savannah River or Lower Three Runs Creek, fish ingestion was the most significant pathway, and the most important radionuclides were generally cesium-137, phosphorus-32, and strontium-90.
3. For people who did not eat fish from bodies of water contaminated by releases of radionuclides to water, milk and beef were the most significant pathways and iodine-131 and tritium were the most important radionuclides.
4. Immersion in argon-41 was a significant, generally small, but constant contributor to dose.
5. Large doses occurred in years corresponding to large releases from the Savannah River Site especially iodine-131; for the Adult Male, Adult Female, and Child Born in 1955, and a large fraction of the total dose was received during the years 1955-1961.
6. There were important differences in doses, pathway significance, and radionuclide significance between children born in 1955 and children born in 1964—those born in 1955 experienced the large iodine releases early in the site history, while those born in 1964 did not experience them.
7. Doses caused by ingesting fish, from Lower Three Runs Creek were significant and higher than doses caused by ingesting fish from the Savannah River.
8. For air releases, the variations in air dispersion of radionuclides from the site generally produced a significant, but not dominant, variation in estimated doses.
9. Consideration of uncertainty in the variables used to estimate doses could cause an estimated dose to be higher or lower than the corresponding point-estimate result. The mean of the distribution of total dose for any receptor ranged between 2.15 to 1.07 times the corresponding point-estimate dose; thus, the means of the uncertain doses were close to the corresponding point –estimate values.
10. The use of hypothetical scenarios to demonstrate the interactions of a range of receptor behaviors with the site and release characteristics was an effective analytical tool.

The largest point-estimate dose for the hypothetical receptors was 0.94-rem (940-mrem) over the 39-year period for the Outdoor Family Child born in 1955. The annual average radiation background exposure for the general U. S. population would result in 14-rem (360-mrem times 39-years) from naturally occurring radioactive materials (NORM) and medical sources during the same 39-year period. Thus, the 39-year average from background sources not from the SRS was 14 times greater than the expected dose from SRS operations during that study period. The statistical uncertainties resulted in a newborn mean dose (1955 maximum dose) of 1.3-rem with a median of 1.1-rem for the 39-year period. The maximum dose was 6-rem and the minimum was 0.25-rem**.** Consideration of these uncertainties would change the range comparison for background to dose from approximately 2.33:1(14/6-mrem) for the maximum to 56:1 (14/0.25-mrem) for the minimum dose exposure. That is, the average annual background was at least 2.33 times greater than the maximum 39-yr SRS dose observed for the CDC scenarios. The corresponding risk of cancer incidence was 0.10 per cent to 0.024 per cent for cancer fatality (CDC 2004).

These scenarios represent risk to the local population born during either 1955 or 1964. ESOP was primarily interested in the relevant pathways and radionuclides today (2004). For the CDC (2004) scenarios exposed to water releases, the relevant pathways over a 39-year period were fish (produced 50% of the ingestion dose for 8 of 12 receptor scenarios, and 83% of the dose for 10 of 12 receptors), and beef (highest % for the remaining two scenarios). The greatest contributors to dose during the 39-year period for the fish and beef pathways were Cs-137, Sr-90, P-32, and I-131. Since the DOE-SR nuclear reactors were shutdown in 1988 except for a test run in 1992 (K reactor test run)(WSRC 1999c), any reactor release radionuclide with a half-life less than 1.6 years is no longer relevant in 2004. It takes ten half-lives to reduce the radionuclide concentration to less than 0.1%. Thus, P-32 (14.29 day half-life) and I-131 (8.04 day half-life), which were major contributors to dose when released, are no longer of concern today (January 2004). However, Cs-137 (half-life 30.17-years) and Sr-90 (half-life 28.60-years), and some long-lived daughter products of other radionuclides may still be significant sources of dose.

The contributions to dose from the CDC (2004) air pathway were greatest for milk and beef for over 75% of the critical pathway scenarios. The major contributors to air dose during the time of release for these scenarios were I-131 and tritium (H-3). Again, due to the shutdown of all SRS reactors by 1992 or before, I-131 is no longer a factor due to its short half-life (8.04–days). Only H-3 is a concern for the public and the environment air dose today since it continues to be released both by the SRS and Plant Vogtle, and it's half-life is 12.280-years. Argon-41 with a half-life of 1.83-hours was only relevant as an air immersion dose the same day of release. The air dose release was approximately 10% of the dose for all scenarios compared to that for the water release dose.

The loss of the major contributors to dose (P-32 and I-131) in the water pathway and air (I-131 and Ar-41) release pathways should result in a much reduced exposure to dose for today's life-style scenarios. Compare the CDC scenario largest mean dose of 1300-mrem (range 250-mrem to 6000-mrem) total dose for the radionuclides of significance to the Table 4 total dose for the future 39-year period based on extrapolated 2002-2004 DOE-SR and ESOP Sportsman MEI dose estimates. The 2002-2004 DOE-SR dose estimates and the 2002-2004 ESOP detected data were totaled, averaged, and multiplied by 39 years to project a future total dose exposure for the ESOP swamp dwelling survivalist-sportsman MEI. This 39-yr extrapolated dose estimate (to year 2041) was compared to the previous 39-year CDC scenario maximum estimates (through 1991) as a worst-case scenario.

ESOP sampling for the period 2002 through 2004 (Table 3, section 5.1.2) detected 81.23% of the DOE-SR estimated dose for the categories compared. The ESOP projected dose estimate for 2002 to 2041, based on a three-year average detection level for the (2002-2004) survivalist-sportsman MEI dose, would be 606-mrem. The SRS Sportsman MEI based on the USDOE SRS Environmental Reports from 2002-2004 with similar pathways would give a projected minimum 39-year exposure of 746-mrem. These two dose estimates of the offsite dose total for the next 39-year period are close to the low end of the CDC 1955/1964 related scenarios dose results range (250-mrem – 6000-mrem). However, if the SRS onsite dose is added to the ESOP survivalist-sportsman who takes part in SRS hunts, the MEI 39-yr exposure would add 1638-mrem to both of the DOE-SR and ESOP projections to give a range of 2244-mrem to 2384-mrem of exposure over the 39-year period (2002 to 2041) for the ESOP projected survivalist-sportsman MEI scenario. This worst-case projection was not corrected for dose losses due to half-life decay factors.

Thus, extrapolation of DOE-SR and ESOP recent dose data to a 39-year future period indicated a wide range of possible dose exposures to the MEI sportsman that was primarily dependent on whether the sportsman consumed deer from onsite or offsite. The SRS (onsite: offsite) total dose ratio (1638/746) for the 2002-2004 period SRS data indicated that the onsite potential contamination for the ESOP survivalist-sportsman scenario was at least two times higher than the offsite dose. Thus, if the CDC scenarios had included onsite exposures for the onsite hunter and fisherman, then the 39-year maximum for a poacher or SRS licensed hunter-fisherman could have been greater than the mean dose of 1300-mrem for an Outdoor Family Child born in 1955. The CDC point estimate uncertainty maximum of 2.15 (2.15 times 940-mrem) allows for the possibility of this dose reaching 2021-mrem. Even the unqualified addition of the DOE-SR projected onsite hunter dose (1638-mrem plus 2021-mrem) would raise the future possible maximum to 3659-mrem. This highly unlikely maximum additional dose for the survivalist-sportsman (3659/14000) would add 26.1 percent to the 39-yr NORM plus medical dose for this worst-case scenario.

However, the CDC estimate included specific radionuclides that are no longer of concern and not part of the ESOP projection estimate. Also, it is interesting and reassuring to note that the ESOP worst-case scenario projected range (2244-mrem and 2384-mrem) is far less than the maximum (6000-mrem) possible dose for the child born in 1955. Thus, the transport of potential dose to the public through onsite hunting has declined as expected due to reduced operations at the DOE-SR and decay factors for the relevant radionuclides.

The 39-year CDC maximum point estimate dose of 940-mrem was greater than the ESOP minimum dose (606-mrem) projection and the DOE-SR minimum dose (746-mrem) projections for the offsite survivalist-sportsman scenario. DOE-SR calculated data models are very conservative and expected to produce a greater dose than the ESOP actual radionuclide detections in the environment. However, the new ESOP survivalist-sportsman scenario uses a few more conservative exposure rates for observed data than the site-specific calculations used by DOE-SR. These different approaches still resulted in the ESOP detected dose being less than the DOE-SR calculated dose and serves to confirm that DOE-SR dose estimates are conservative. Reduced future offsite exposure was expected since the major dose contributors (I-131, Ar-41, and P-32) associated with reactor operations and processing are no longer dominant factors. The addition of an onsite survivalist-sportsman dose estimate to the Outdoor Family Child and River Dweller CDC scenario would have increased the dose estimates for the past 39-yr periods considered by the CDC.

The maximum dose exposure to the survivalist-sportsman MEI occurred with the onsite hunter, the offsite swamp hunter, and the offsite swamp fisherman in that order. The air and liquid dose pathways were responsible for less than 0.3 % of the potential dose experienced by the worst-case scenario for the offsite survivalist-sportsman from 2002 to 2004. Thus, the general public who was exposed to only offsite Savannah River water and air should receive a dose of less than 5.9-mrems over the next 39-years based on the ESOP 2002 -2004 dose projection.

However, there is groundwater contamination in the H and F areas presently confined to the SRS. The down-gradient wells, surface water, sediments, plants, and animals should be carefully monitored for any signs of the very toxic elements that are present at tank farms and seepage areas. Early detection is paramount to protecting the public and the environment. Increased background and perimeter sampling by ESOP started in 2004 to improve the evaluation of background and perimeter radionuclide concentrations.

The next phase of the ESOP critical pathway assessment will be updated to include a survey of nonradiological toxic chemicals at the SRS.

CONCLUSIONS AND RECOMMENDATIONS

The primary radiological contaminants currently released into the atmosphere and detected by the cow-milk pathway were tritium, I-129, unspecified alpha, non-volatile beta, Pu-238, Cs-137, Pu-239, U-234, and U-238 (WSRC 2005). ESOP detected atmospheric dose in 2004 came mostly from the alpha in soil, ambient beta-gamma, re-suspension of U-234, Ac-228, Cs-137, U-238, Pb-212, Pb-214, Ra-226, and tritium releases (SCDHEC 2005). Radionuclides that made up the major contaminant dose for liquid releases at the SRS included Cs-137, tritium, alpha, I-129, Sr-90, and non-volatile beta (WSRC 2005). ESOP detected liquid pathway dose in 2004 came mostly from Cs-137 in deer and fish, alpha, Sr-89 in milk solids, beta, Sr-90, and tritium (SCDHEC 2005).

The major radionuclides released from DOE-SR in detectable concentrations from 1993 through 2004 were tritium, I-129, Cs-137, and Pu-239 (for atmospheric releases), and Cs-137, tritium, alpha, I-129, beta, Pu-239 and Sr-90 (for liquid releases). It should be noted that the SRS Environmental Reports from 1993 through 2004 assigned unspecified alpha and beta concentrations to Pu-239, and Sr-90, respectively. The alpha- and beta-emitting radionuclides (WSRC 2001) contributed substantial unspecified dose based on the Pu-239 and Sr-90 dose factors. Therefore, Pu-239, and Sr-90 doses are potentially inflated due to the incorporation of the dose from naturally occurring alpha- and beta-emitters. Also, some naturally occurring NORM above background may reflect local soil characteristics rather than contributions from the SRS, but were assumed of SRS origin if above the South Carolina average background.
The DOE-SR report of “maximum potential all-pathway and sportsman doses” calculated the external exposure, ingestion, and inhalation routes of public exposure to radionuclides. The onsite game animal, offsite game animal, fish, and direct external radiation exposure pathways were the primary contributors of dose. Feral hog consumption was the greatest contributor to ESOP offsite dose in 2002, but it was not sampled in 2004 (no samples found). Ingestion of foods such as offsite game animals, fish, vegetation, and surface water are important contributors to the public’s potential dose. Although highly variable, the potential dose involving game animal radionuclide concentrations should be greater than the fish exposure from year to year. ESOP plans to investigate possible contributions (fungi consumption) that may affect this highly variable game animal radionuclide concentration. Radionuclides released into the atmospheric and liquid pathways also provided a significant dose to exposure pathways. However, the primary source of radiological exposure today is presently provided through the sportsman dose scenario. The sportsman dose received by onsite and offsite hunters, and offsite fishermen from 1993 through 2004 was greater than all other exposure pathways combined (WSRC 1994, 1995,

1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, and 2004). Both the ESOP and DOE-SR dose estimates and detections were less than the air and liquid USDOE dose limits.

A higher onsite dose and ESOP projected 39-yr exposure for the survivalist-sportsman indicated that long-lived radionuclides still present in and around the SRS will play a major role in determining dose exposure to the survivalist-sportsman, the public and environment in the future. The ESOP 39-yr projected survivalist-sportsman scenario offsite dose estimates to the year 2041, (606-mrem from ESOP data, and 746-mrem from DOE-SR data), are less than the CDC scenario closest point estimate (940-mrem) for a past 39-yr period to a child born in 1955. These represent expected differences between conservative estimates and detected data. The ESOP estimate is entirely from observed data, but assumed more conservative consumption rates for some media. DOE-SR and CDC projections involve modeling and very conservative assumptions.

In the future, potential atmospheric and liquid release scenarios that may increase the dose to the surrounding public will include the following:

- releases of Am-241, plutonium and uranium radionuclides from MFFF facility through the air and surface water environmental mediums (Duke Cogema Stone & Webster 1998);
- computer models predict a high concentration of tritium migrating to Upper Three Runs from ORWBG (WSRC 2001);
- radionuclides such as C-14, I-129, Np-237 and Tc-99 may be an ORWBG contaminant to monitor in the future because of their long half-lives.

These findings indicated that environmental monitoring programs should focus on the survivalist-sportsman, swamp sediment and soil exposure, inhalation, drinking water, vegetation, and air exposure pathways. The down-gradient wells, surface water, sediments, plants, and animals should be carefully monitored for any signs of the very toxic elements that are present at tank farms, basins and seepage areas. Early detection is paramount to protecting the public and the environment should there be a release to the environment.

LIMITATIONS OF THIS STUDY

This assessment is based on a document review and current estimates of dose exposure to the survivalist-sportsman MEI. ESOP personnel have not verified referenced material used in this assessment. ESOP will continue to monitor the SRS and adjacent area for the primary radiological contaminants and other contaminants associated with DOE-SR operations.

Increased background and SRS perimeter sampling by ESOP started in 2004 and should improve the evaluation of background and perimeter concentrations. The lack of observations due to the limitations or unavailability of extremely low-level isotopic analysis in past analyses may significantly affect comparison of future and past dose estimates. Budgetary constraints limit the number and types of radionuclides that can be sampled in a given year and contribute to the variance in dose estimates.

5.1.2 Tables and Figures
Critical Pathway

Table 1. Primary Atmospheric Contaminants Identified in the RAC Report, SRS Environmental Reports and ESOP Project Reports.

RAC Report	SRS Environmental Reports	ESOP Project Reports
tritium	tritium	tritium
C-14	C-14	Cs-137
Ar-41	*I-129*	Alpha
Sr-89,90	*Sr-89,90*	Beta
I-129	*Ru-106*	Sr-89,90
I-131	*Cs-137*	U-238
Cs-137	*U-234*	Am-243
ruthenium-103 (Ru-103)	*U-235,238*	
Ru-106	*Cm-244*	
Am-241	*Pu-238*	
Pu-238	*Pu-239*	
Pu-239,240	*Am-241*	
Uranium	*Alpha*	
	Nonvolatile Beta	

Tables and Figures
Critical Pathway

Table 2. Primary Liquid Contaminants Identified in the RAC Report, SRS Environmental Reports and ESOP Project Reports.

RAC Report	SRS Environmental Reports	ESOP Project Reports
tritium	*tritium*	tritium
P-32	*Sr-89,90*	Sr-90
S-35	*Sr-90*	I-129
Co-60	*I-129*	Cs-137
Zn-65	*Cs-137*	Alpha
Sr-89	*U-234*	Beta
Sr-90	*Pu-239*	Ra-226,228
Y-91	*Alpha*	U-238
Zr, Nb-95	*Non-volatile Beta*	
Tc-99	*Tc-99*	
I-129	*U-235*	
I-130	*U-238*	
Cs-137	*Pu-238*	
Pu-238		
Pu-239		
plutonium-240 (Pu-240)		
Uranium		

Tables and Figures
Critical Pathway

Table 3. Comparison of 39-year Projections For Dose to the MEI.

PATHWAYS	**SRS (1)**	**SCDHEC (2)**	**CDC (3)**
Dose Totals (mrem) (4)	**2002-2004**	**2002-2004**	**1955/1964**
Air	0.19	0.00	
Liquid	0.33	0.15	
CM Fisherman	1.90	1.35	
Offsite Deer	30.70	38.45	
Soil Exposure (OfS) (6)	13.20	1.84	
Hog	9.48	4.77	
Swamp Soil (SFM) (7)	1.62	0.03	
Total Offsite Dose	57.42	46.59	
Avg Offsite Hunter/yr	19.14	15.53	
39-yr Offsite Dose	**746**	**606**	**940**
Total Onsite Dose	126		
Avg Onsite Hunter	42		
39-yr Onsite Hunter	**1638**	**1638**	
39-yr SRS Sportsman	**2384**	**2244**	

Notes:

1. **The SRS data came from the SRS Environmental Reports estimates.**
2. **The SCDHEC data came from maximum detections.**
3. **The CDC scenarios largest point estimate dose for a 39 yr study period.**
4. **All dose is given in millirems (mrem) and is rounded at 0.005-mrem.**
5. **Data comparison is limited to the air, river water, hunter-fisherman scenario.**
6. **"OfS" is offsite.**
7. **"SFM" is swamp fisherman soil.**

Tables and Figures
Critical Pathway

Figure 1. MEI from Atmospheric Releases (MAXIGASP-SR code) Percent of Total Dose

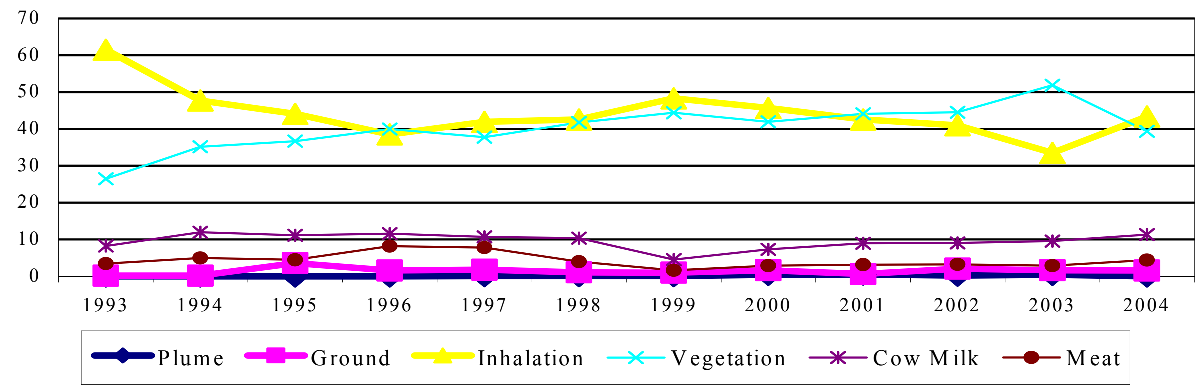
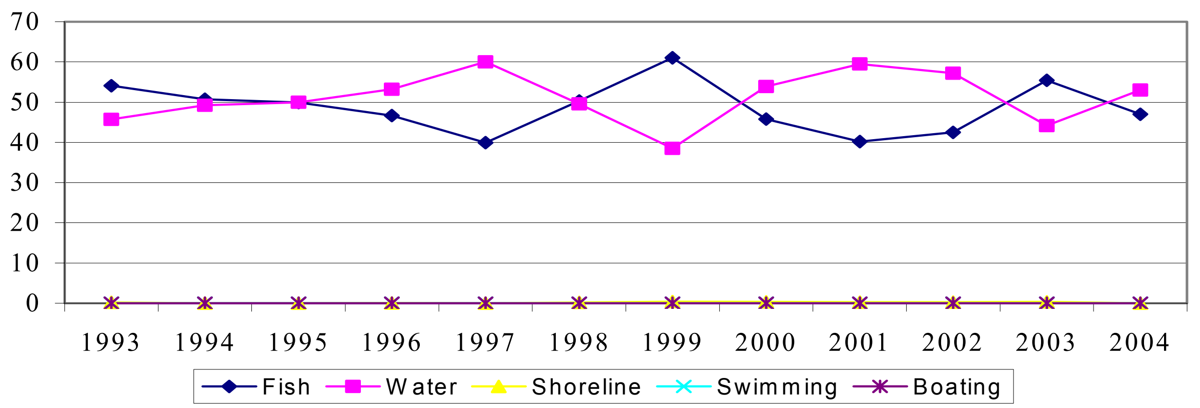


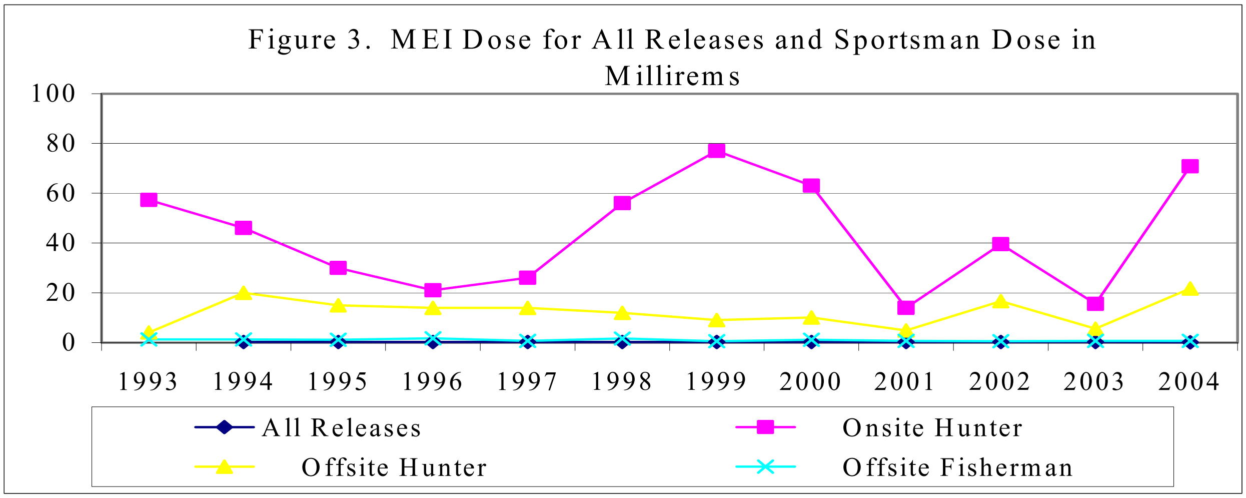
Figure 2. Percent of Total Dose to the MEI from Liquid Releases



Notes:

1. Data came from the SRS Environmental Reports (WSRC) for 1993, 1994, 1995, 1996, 1997,1998,1999, 2000, 2001, 2002, 2003, 2004, and 2005.

Tables and Figures
Critical Pathway



Notes:
1. Data came from the SRS Environmental Reports (WSRC) for 1993, 1994, 1995, 1996, 1997,1998,1999, 2000, 2001, 2002, 2003, 2004, and 2005.

5.1.3 Data
Critical Pathway Data

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

Radionuclide	1993	1994	1995	1996	1997	1998
Ac-228						
Al-26		3.50E-14	1.50E-14			
Am-241			1.81E-16	4.20E-07	8.70E-07	5.75E-06
Am-241, 243	8.86E-13	8.86E-10				
Am-243			2.30E-17	1.76E-05	1.76E-05	1.89E-05
Ar-39						
Ba-133					3.00E-12	
Be-7		1.50E-13				
C-14	4.00E-06	3.50E-13	9.80E-15	5.88E-09	1.85E-08	9.68E-05
Ca-45		1.00E-15				
Ca-47		1.00E-16				
Cd-109		5.00E-14	5.21E-14			
Ce-139			1.00E-16			
Ce-141			5.30E-05			4.16E-05
Ce-144	1.13E-13	1.13E-10	2.32E-04	7.36E-06	6.11E-06	1.45E-04
Cf-249						5.27E-16
Cf-251						2.17E-14
Cl-36		1.00E-15				
Cm-242			2.03E-16	2.03E-16	8.19E-12	1.58E-07
Cm-242, 244	7.33E-12	7.32E-09				
Cm-243		1.00E-13	4.90E-14			
Cm-244				1.28E-04	1.28E-04	1.30E-04
Cm-245					1.88E-12	2.08E-13
Cm-246						9.37E-07
Cm-248		9.20E-18	9.20E-18			
Co-57		2.50E-14	2.50E-14		1.04E-09	9.40E-11
Co-58			2.60E-05		1.67E-12	1.27E-04
Co-60	3.34E-17	1.08E-13	2.71E-05	4.71E-07	9.13E-07	1.38E-04
Cr-51			1.00E-16			1.21E-04
Cs-134	1.40E-17	2.01E-13	2.98E-05	2.49E-15	1.21E-09	1.31E-04
Cs-137	4.33E-11	1.08E-08	1.40E-02	4.33E-03	4.19E-03	4.89E-03
Eu-152					5.32E-09	4.19E-08
Eu-154	3.44E-13	3.44E-10		6.42E-06	6.42E-06	5.74E-06
Eu-155	1.63E-13	1.63E-10		1.66E-06	1.66E-06	1.10E-06
Fe-55						3.90E-04
H-3 (total)	4.31E+01	1.31E+02	3.32E+01	2.23E+02	1.53E+02	9.31E+02
Hg-203		2.00E-12	1.00E-12			
I-129	6.88E-07			3.83E-06	1.22E-07	1.29E-05
I-131			2.05E-02			
Kr-85						
Mn-54		1.50E-15			4.80E-12	
Na-22					1.11E-09	7.76E-11
Nb-94						
Nb-95			2.67E-05	1.55E-15	1.55E-15	1.13E-04
Ni-59				2.51E-08	3.24E-10	8.33E-13
Ni-63	2.00E-07	2.06E-13	2.00E-13		2.29E-09	8.21E-06

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

Radionuclide	1993	1994	1995	1996	1997	1998
Np-237		7.40E-15		4.66E-08	1.38E-09	1.01E-09
Np-239				2.17E-07	2.17E-07	
Pa-231				1.00E-09	1.00E-09	1.00E-09
Pa-233						
Pa-234					2.26E-10	
Pb-214						
Pm-144					1.34E-12	
Pm-147			7.92E-07	6.75E-06	1.01E-08	9.79E-10
Pr-144						
Pr-144m						
Pu-236		1.90E-17				
Pu-238	4.63E-12	5.18E-07	6.61E-06	5.19E-06	3.55E-04	3.28E-04
Pu-239	4.70E-07	6.45E-07	2.21E-06	1.83E-04	6.92E-06	1.41E-03
Pu-240				2.11E-07	1.11E-06	1.12E-06
Pu-241				3.75E-06	5.16E-05	6.02E-05
Pu-242					3.66E-11	1.59E-07
Ra-226					1.24E-08	8.64E-06
Ra-228					1.75E-10	2.13E-05
Rb-86		2.00E-15	2.00E-15			
Ru-103			3.72E-05			2.26E-05
Ru-106	4.96E-12	4.97E-09	1.80E-04	7.00E-02	7.00E-02	2.26E-05
S-35	2.00E-06	6.85E-12	5.26E-12			
Sb-124					3.36E-12	
Sb-125	7.27E-15	7.27E-12	1.19E-04	2.28E-04	5.93E-07	5.27-05
Sc-46		1.00E-16				
Se-75		6.00E-16				
Se-79				2.47E-08	2.15E-10	1.85E-11
Sn-113			3.80E-16			
Sn-126				6.79E-09	3.36E-15	1.29E-13
Sr-85		5.00E-15	5.20E-16			
Sr-89,90	1.11E-04	3.75E-04	3.03E-04		8.21E-05	2.58E-02
Sr-90				4.75E-04		
Tc-99				2.65E-08	3.61E-08	2.82E-05
Th-228					2.15E-10	9.44E-06
Th-230					2.03E-10	1.02E-05
Th-231						
Th-232				1.28E-08	1.40E-10	7.51E-07
Th-234					2.26E-10	
U-232						
U-233				1.62E-08	2.11E-08	2.35E-06
U-234				2.93E-07	1.45E-05	1.83E-05
U-235			1.44E-15	4.10E-05	4.84E-07	2.10E-06
U-235, 238	4.74E-05	8.12E-06				
U-236				5.79E-08	4.84E-07	2.39E-09
U-238			2.87E-09	1.35E-06	3.45E-05	5.12E-05
Y-88			9.10E-16			
Zn-65		2.60E-13	6.24E-05	1.46E-16	3.69E-12	2.23E-05
Zr-85						
Zr-95	2.39E-14	2.39E-11	4.51E-05	2.13E-05	2.13E-05	1.71E-05

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

Radionuclide	1999	2000	2001	2002	2003	2004
Ac-228	1.66E-06	1.80E-06	4.07E-06	1.72E-06	1.64E-06	1.60E-07
Al-26						
Am-241	8.44E-06	1.24E-04	1.15E-04	1.16E-04	1.13E-04	6.92E-06
Am-241, 243						
Am-243	4.28E-06	6.02E-06	9.90E-07	4.84E-08	7.95E-06	6.27E-08
Ar-39		3.30E-05				
Ba-133		5.40E-10				
Be-7						
C-14	4.92E-04	8.39E-05	8.76E-05	1.19E-04	9.42E-05	
Ca-45						
Ca-47						
Cd-109						
Ce-139						
Ce-141	4.16E-05	4.16E-05	4.16E-05	4.16E-05	4.16E-05	4.16E-05
Ce-144	1.45E-04	1.44E-04	1.43E-04	3.01E-04	1.43E-04	1.42E-04
Cf-249						
Cf-251						4.31E-07
Cl-36						
Cm-242	3.10E-07	4.47E-07	1.43E-08		2.03E-16	2.03E-06
Cm-242, 244						
Cm-243				6.23E-07	4.92E-07	4.92E-07
Cm-244	6.74E-06	6.19E-05	4.76E-05	4.77E-05	4.79E-05	8.62E-07
Cm-245		1.04E-13	4.18E-07			
Cm-246	2.91E-06	3.98E-06	1.01E-06			
Cm-248						
Co-57	2.01E-04	3.61E-10				8.34E-10
Co-58	1.27E-04	1.27E-04	1.27E-04	1.27E-04	1.27E-04	1.27E-04
Co-60	1.28E-04	8.58E-04	8.59E-04	8.58E-04	8.57E-04	1.30E-04
Cr-51	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04
Cs-134	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04
Cs-135						2.25E-09
Cs-137	6.11E-03	2.07E-03	2.22E-03	1.47E-02	1.42E-02	1.21E-02
Eu-152	1.21E-10	4.13E-05	4.15E-05	4.13E-05	4.13E-05	
Eu-154	5.74E-06	1.51E-05	1.53E-05	1.67E-05	1.51E-05	4.37E-09
Eu-155	1.10E-06	6.81E-07	7.85E-07	8.28E-07	6.76E-07	3.72E-09
Fe-55						
H-3 (total)	4.71E+02	6.12E+02	6.07E+02	1.26E+03	2.37E+03	
Hg-203	2.23E-10	2.23E-10	2.29E-10			
I-129	2.50E-03	1.71E-03	1.29E-06	8.65E-04	8.62E-04	
I-131						
K-40						2.76E-08
Kr-85		2.00E-03		1.19E-04		
Mn-54		1.30E-10	2.52E-08		9.46E-07	9.46E-07
Na-22		7.90E-11	2.09E-08	1.97E-09		
Nb-94	3.95E-10	3.95E-10	4.56E-08			
Nb-95	1.13E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04
Ni-59	1.02E-09	4.17E-13				2.06E-08
Ni-63	5.89E-07	5.09E-06	4.38E-06	1.81E-06	1.43E-06	1.45E-06

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

Radionuclide	1999	2000	2001	2002	2003	2004
Np-237	2.23E-10	2.26E-10	1.09E-08	8.50E-09		5.12E-08
Np-239	4.51E-09		1.24E-07	7.08E-09		7.79E-09
Pa-231						
Pa-233	2.23E-10	2.23E-10	2.29E-10			
Pa-234			1.76E-08		4.98E-06	7.81E-07
Pa-234m						4.82E-10
Pb-212						1.03E-09
Pb-214	2.23E-10		6.58E-07	6.58E-07	1.60E-06	9.46E-07
Pm-144						4.05E-13
Pm-147	3.49E-09	1.30E-05	1.34E-05	1.30E-05	1.30E-05	5.35E-15
Pr-144	3.45E-09	3.68E-13		1.00E-07		
Pr-144m		4.43E-15				
Pu-236			1.22E-10	3.66E-10	2.58E-10	1.31E-07
Pu-238	1.45E-03	7.57E-05	3.99E-05	5.86E-04	2.25E-04	3.89E-04
Pu-239	1.68E-05	1.86E-03e	1.94E-03	1.90E-03	1.91E-03	1.09E-04
Pu-240	1.46E-06	1.99E-07	8.51E-07	1.57E-05	1.14E-04	3.38E-06
Pu-241	6.47E-05	4.09E-06	6.70E-06	1.42E-04	4.36E-05	8.35E-07
Pu-242	1.53E-08	7.03E-09	2.09E-08	3.98E-06	5.25E-08	5.90E-08
Ra-226	1.25E-05	1.74E-05	5.25E-06	9.97E-07		
Ra-228	1.87E-05	2.74E-05	4.16E-06	9.46E-07		1.50E-07
Rb-86						
Ru-103	4.23E-05	4.23E-05	4.23E-05	4.23E-05	4.23E-05	4.23E-05
Ru-106		1.04E-05	9.92E-07	1.04E-03	1.40E-06	2.18E-08
S-35						
Sb-124	2.23E-10	5.63E-10	8.09E-09			1.54E-08
Sb-125	5.27E-05	5.34E-05	5.37E-05	2.61E-04	2.01E-04	2.00E-04
Sc-46						
Se-75						
Se-79		4.47E-09		1.26E-05	9.95E-06	1.00E-05
Sn-113		6.20E-10				5.64E-10
Sn-126	3.13E-15	6.45E-14				3.01E-09
Sr-85						
Sr-89	7.02E-04	3.72E-03e				1.62E-06
Sr-90			3.57E-03	3.85E-03	3.52E-03	3.10E-04
Tc-99	6.22E-05	8.75E-05	1.89E-06	6.04E-03	4.77E-03	4.77E-03
Th-228	2.75E-07	5.76E-07	3.97E-06			9.38E-10
Th-229						5.77E-09
Th-230	1.22E-05	1.74E-05	2.71E-06			5.82E-10
Th-231				4.63E-13		4.63E-13
Th-232	1.64E-06	2.58E-06	1.75E-06			9.71E-10
Th-234	4.10E-06	1.04E-04	1.03E-04	9.98E-05	1.04E-04	1.08E-06
U-232			4.46E-11	7.37E-06	3.64E-06	3.64E-06
U-233	2.38E-06	1.50E-08	3.90E-08	4.32E-05	3.31E-05	3.95E-05
U-234	5.29E-05	3.59E-04	2.84E-04	3.31E-04	5.18E-04	7.99E-04
U-235	5.89E-06	1.44E-05	6.59E-06	8.46E-06	1.27E-05	2.37E-04
U-236	5.20E-09	4.16E-11	7.17E-10	3.45E-06	2.30E-05	3.29E-05
U-238	9.49E-05	4.47E-04	3.18E-04	3.19E-04	1.14E-03	7.30E-04
Y-88						
Zn-65	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05
Zr-85		1.07E-09				
Zr-95	1.71E-05	1.68E-05	1.68E-05	1.72E-05	1.68E-05	1.68E-05
Alpha	1.47E-03	5.86E-04	1.33E-03	5.47E-04	4.15E-04	5.70E-04
Nonvolatile Beta	2.74E-02	3.47E-02				
Beta-Gamma			3.22E-02	2.50E-02	2.49E-02	2.57E-02

1. Empty cells indicate no data reported.

Critical Pathway
Radionuclides that consist of greater than or equal to 1% of the total dose from atmospheric releases.

Radionuclides	1993	1994	1995	1996	1997	1998
Am-241						
C-14				4.3		
Cs-137			4.4	1.5	1.6	1.2
H-3	89	88.0	77.5	68.0	71.3	66.8
I-129	2.5	2.4	4.8	11.0	8.6	10.3
Pu-238	3.1	5.0	2.8	2.3	3.0	2.1
Pu-239	3.5	2.7	7.9	5.0	8.0	15.0
Ru-106				5.0	5.5	
Sr-90						3.4
U-234						
U-235, 238		1.4				
U-238				1.1		
Alpha						
Nonvolital Beta						

Radionuclides	1999	2000	2001	2002	2003	2004
Am-241		1.64	1.82	1.01		0.17
C-14						
Cm-244						0.02
Co-60						0.03
Cs-134						0.01
Cs-137	1.3	1.90		2.45	1.85	2.01
H-3	27.8	49.53	51.24	49.67	38.8	73.93
I-129	4.2	3.34	15.93	17.74	33.27	9.94
Pu-238	8.2	2.53		3.92	1.25	2.57
Pu-239		22.86	15.65	13.82	12.23	1.83
Pu-240						0.02
Ru-106						
Sr-90						0.04
Tc-99						0.07
U-232						0.02
U-233						0.05
U-234	1.2					1.08
U-235						0.3
U-236						0.04
U-238					1.29	0.98
Alpha	41.6	7.78	8.93	6.51	6.12	4.19
Nonvolital Beta	13.5	6.48	2.9	2.5	1.9	2.69

1. Empty cells indicate no data reported.

Critical Pathway
Radionuclides that consist of greater than or equal to 1% of the total dose from atmospheric releases.

Radionuclides	1993	1994	1995	1996	1997	1998
Cs-137	51.0	47.3	46.8	43.2	35.8	47.2
H-3 (oxide)	40.5	41.7	43.2	40.5	39.8	36.3
I-129		1.7		2.1	2.2	1.6
Pu-239	2.2	4.0	4.3	8.8	17.2	9.4
Sr-89, 90		5.3				
Sr-90	5.5		5.4	4.2	3.6	3.8
U-234						
Alpha						
Nonvolital Beta						

Radionuclides	1999	2000	2001	2002	2003	2004
Am-241						<1
Cm-244						<1
Cs-137	59.11	42.89	35.84	39.1	53	42
H-3 (oxide)	25.08	41.41	38.14	40.02	31	36
I-129	1.89	3.29	4.19	3.93	2	5
Pu-238						<1
Pu-239						<1
Sr-89, 90	1.91	1.36				
Sr-90				1.03	1	3
Tc-99						<1
U-234	1.72					<1
U-235						<1
U-238						<1
Alpha	9.00	9.89	18.43	1.13	2	11
Nonvolital Beta		1.11	2.69	14.75	10	2

1. Empty cells indicate no data reported.

Critical Pathway
Percent of total dose to MEI from atmospheric and liquid releases

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Plume	0.0001	0.0001	0.00001	0.03	0.05	0.07	0.10	0.40	0.50	0.24	0.40	0.00
Ground	0.2	0.2	3.6	1.6	1.8	1.1	1.0	1.7	0.7	2.1	1.7	1.6
Inhalation	61.5	47.7	44.1	38.5	41.9	42.6	48.3	45.7	42.6	41.0	33.5	43.4
Vegetation	26.5	35.2	36.7	40.0	37.8	41.8	44.4	41.9	44.1	44.5	51.9	39.4
Cow Milk	8.3	12.0	11.2	11.6	10.7	10.4	4.6	7.3	9.0	9.1	9.6	11.3
Meat	3.5	5.0	4.5	8.2	7.8	4.0	1.7	2.9	3.2	3.2	2.9	4.4

MEI from Liquid Releases Percent of Total Dose

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fish	54.1	50.7	49.9	46.7	39.9	50.3	61.03	45.82	40.21	42.47	55.44	47
Water	45.7	49.2	50.0	53.2	60.0	49.6	38.54	53.85	59.51	57.22	44.18	53
Shoreline	0.2	0.02	0.02	0.1	0.01	0.2	0.42	0.31	0.27	0.29	0.37	<1
Swimming	0.0001	0.0001	0.0001	1E-04	1E-04	1E-04	0.01	0.02	0.02	0.02	0.01	<1
Boating	0.0001	0.0001	0.0001	1E-04	1E-04	1E-04	2E-04	1E-04	1E-04	1E-04	1E-04	<1

Committed dose (mrem) for MEI and sportsman pathways.

Path / Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
All Pathway		0.23	0.2	0.19	0.18	0.19	0.28	0.18	0.18	0.18	0.19	0.15
Onsite Hunter	57.3	46	30	21	26	56	77	63	14	39.5	15.6	70.8
Offsite Hunter	4.1	20	15	14	14	12	9.1	10.1	0.53	12.2	1.2	17.3
Offsite Fisherman	1.3	1.3	1.2	1.7	0.65	1.6	0.61	1.18	1.74	0.62	0.66	0.71

1. Empty cells indicate no data reported.

5.1.4 Summary Statistics
Critical Pathway

Dose (mrem) to the Public From DOE-SR 50-Mile Perimeter Media Samples

	2004	**1999-2004*5**
Sportsman MEI*1	18.38	10.02
Average Sportsman*2	3.47	8.81
Non-sportsman*3	2.19	3
General Public*4	0.49	0.14

Notes:
*1 - Based on the maximum exposure of a single hunter.
*2 - Based on the average exposure for all deer radionuclide detections.
*3 - Based on the public who was exposed to swamp and forest soils.
*4 - Based on the general public who was not exposed to swamp or forest soils. Increase in dose in 2004 due to an improved lower background.
*5 - Based on the 2004 SCDHEC Radiological Dose Calculation report tables (SCDHEC 2005b). Average dose 1999-2004.

6.1 2004 Dose Calculation

6.1.1 Summary

Atmospheric and liquid discharges from the Savannah River Site (SRS) are monitored by the Department of Energy – Savannah River (DOE-SR) contractor Westinghouse Savannah River Company Environmental Monitoring Section. The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) also monitored the SRS and perimeter areas under an Agreement in Principle with the DOE. DOE-SR and ESOP used data from these monitoring activities to calculate the potential radiation dose to the surrounding public. ESOP implemented a Radiological Dose Calculation Project in 2002 to calculate the potential exposure or dose to the public around the SRS, and evaluated DOE-SR dose results published in the SRS Environmental Reports.

The dose estimates produced by SDHEC were calculated from radiation activity concentrations for all exposure media sampled, including air, game animal, thermoluminescent dosimeters (TLD), milk, edible vegetation, soil, surface water, sediments, drinking water, fish, groundwater, and game animals. Dose concentrations were calculated using standard dose calculations based on the International Commission of Radiological Protection (ICRP) publications 30/48 and the U. S. Environmental Protection Agency (USEPA) Federal Guidance Report updates 11 and 12 from the Oak Ridge National Laboratory. Data provided to this project were collected from locations off the SRS and summarized as annual average concentrations for each contaminant, to calculate the potential radiation dose to the maximally exposed individual (MEI). The MEI was defined as a hypothetical adult member of the surrounding population who received the maximum dose from the SRS routine air and liquid releases. Consumption rates used in this project were found in publications by the Nuclear Regulatory Commission, the USEPA, the D.M. Hamby publication and a 1995 Strange and Chamberlin Multimedia Environmental Pollutant Assessment System exposure pathway model.

This project used dose instead of risk so that direct comparisons of dose magnitude can be made with data published in the SRS Environmental Reports. USEPA and ESOP both use risk calculations when determining clean-up levels at Comprehensive Environmental Resource Compensation and Liability Act and Resource Conservation Recovery Act sites.

RESULTS AND DISCUSSION

Radiation exposures to the MEI from each exposure media were categorized into primary exposure routes and pathways (atmospheric, liquid pathways) that are subdivided into other more specialized exposure pathways (sportsman or hunter-fisherman) or media. The dose from the radionuclides were organized to represent an additive dose estimate (Table 1, section 6.1.2) for 2004 occurring in specialized pathways (section 6.1.3) which represented types of media exposure and lifestyle (e. g., potable and nonpotable drinking water, and the sportsman lifestyle). Note that all drinking water doses are not added together, since a source for a particular scenario had to be assumed. A brief comparison was made to dose values published by the DOE-SR. This comparison assisted the ESOP in evaluating the 2004 DOE-SR environmental monitoring program.

The Atmospheric Pathway

ESOP Air Inhalation Dose Results

Because radiological activity was difficult to detect at the SRS boundary, DOE-SR used a MAXDOSE-SR computer-modeling program to estimate the dose values to the MEI (WSRC 2002). Data used in the DOE-SR monitoring program were from stack emissions as well as diffuse and fugitive emissions around the SRS (WSRC 1999, 2000, 2001, 2003, 2004, 2005).

Figure 1 in section 6.1.2 shows the comparable dose values in mrem, calculated by ESOP (section 6.1.3), for different media and pathways from 1999 to 2004 (SCDHEC 2003). The 0.002-mrem ESOP MEI air dose in 2004 was typical of detections in past years of less than 0.01-mrems, and below the DOE-SR 2004 air dose estimate of 0.06-mrems (WSRC 2005). This difference in the air pathway was due primarily to the fact that the DOE-SR air dose was calculated from release estimates from diffuse and fugitive sources and represents a conservative potential dose.

The inhalation pathway dose attributed to resuspended soil and sediment was more significant (0.19-mrem), and was predominantly influenced by uranium-234 (U-234), which is naturally occurring. The U-234 dose estimate from coastal plains soils was included in the DOE-SR perimeter dose only because it was greater than a random background average that included piedmont soils. Some of the Naturally Occurring Radiological Material (NORM) occurring in the soil and sediment samples were considered to be possibly of DOE-SR origin since these thorium and uranium decay series products were produced or stored at the SRS. However, the two samples that were greater than background for U-234 were taken from the floodplains of the North Fork Edisto River and the South Fork Edisto River. Therefore, some of this U-234 dose could be due to erosion of saprolitic formations (rather than an aerial deposition) from upstream areas that are known to contain higher levels of naturally occurring uranium and radium (SCDHEC 2005). This detection dose estimate was flagged as possibly not of SRS origin, and possibly a NORM contributor.

Thermoluminescent Dosimeter (TLD) Dose Results

The TLD are replaced quarterly and deployed one meter above the soil in various locations to measure ambient beta-gamma continually. The TLD exposures above background levels (NORM in plants and soil) were considered as originating from artificial sources. The direct exposure from all SRS perimeter TLD, minus the outer perimeter background TLD, averaged 0.25-mrem in 2004 for unknown beta/gamma activity. Use of the average outer perimeter locations as background instead of a single location accounted for the effects of differing soil types and the resident NORM on TLD exposure. Background cosmic radiation accumulated by the TLD during airline transport to and from the vendor for analysis was subtracted from the TLD yearly averages to obtain the gamma dose at the SRS perimeter locations. ESOP plans to establish a background location near Savannah, Georgia in 2005 to improve the air background data.

ESOP Edible Vegetation Dose Results

The ESOP MEI total dose above background for edible vegetation (squash, etc.) came from only one radionuclide (tritium at 0.011-mrem). The MEI dose from vegetable consumption was rounded off to 0.01-mrem (2 significant figures), and was far less than that typically received from watching TV for one year (1-mrem/yr).

ESOP Soil Ingestion Dose Results

Six gamma-producing radioisotopes produced detectable concentrations in surface soil samples. Surface soil dose was considered to come from ingestion, direct radiation exposure, and inhalation of resuspended soil (including dried sediments) due to farming and wind erosion. NORM detection levels greater than background reflect soil type source differences or sources other than SRS.

NORM detection levels greater than background that were also produced or stored by DOE-SR were considered as originating from an SRS aerial deposition or upstream liquid sources. All gamma dose in soils, except for cesium-137 (Cs-137), came from uranium (U-234), radium-226 (Ra-226), lead (Pb-212 and Pb-214) and actinium-228 (Ac-228) and totaled less than 0.37-mrem or 23.1% of the soil dose. Alpha detections were assumed to come from Pu-239 and gave the highest total dose (1.20-mrem or 75% of the soil dose) for surface soil ingestion, direct exposure, and resuspension inhalation.

The inhalation pathway dose attributed to resuspended soil and sediment (0.19-mrem), was predominantly U-234 (77.4% of the resuspended soil dose), and Ra-226, which are naturally occurring radioisotopes. These NORM were included in the DOE-SR perimeter dose because they were greater than the background average that included piedmont soils. However, the two samples that were greater than background for U-234 were taken from the floodplains of the North Fork Edisto River and the South Fork Edisto River. This U-234 dose could be due to erosion of saprolitic granite from upstream areas that are known to contain higher levels of naturally occurring uranium and radium in groundwater. Thus, this detection dose estimate above background was flagged as possibly NORM only, and not an SRS aerial deposition. However, 76.88% (1.23-mrem) of the detected soil dose (1.60-mrem) came from Cs-137 and unknown alpha, both of which are considered non-NORM contaminants. The possible ingestion of unknown alpha (1.19-mrem) was the dominant part of the soil dose.

The ingestion of contaminated sediment and soil along the banks of SRS streams during consumption of aquatic food (fish), and inhalation of resuspended soil (dried sediment and soil on stream banks) contributed to the MEI dose. Wet soil and clothing greatly reduce beta penetration to the skin and direct exposure to gamma (shine) from surface soil.

Milk Dose Results

The ESOP MEI total dose above background for cow milk in 2004 (section 6.1.3) was 0.18-mrem/yr. Most of that dose was due to strontium-89 (Sr-89) found in milk solids (0.169-mrem), which represented concentrated forms of milk products. Strontium-90 (0.006-mrem) and Cs-

137 (0.001-mrem) represented the dose in liquid cow milk. Goat milk samples contained only Sr-90 at 0.003-mrem of dose. Milk produced the third highest dose within the food group in 2004 (Figure 2, section 6.1.2). Goat milk gave the highest detections in 2003 compared to cow milk in 2004. The ESOP overall average cow milk dose since 1999 was 0.04-mrem with a range of 0 to 0.09-mrem (section 6.1.3). This milk dose was far less than that received by watching TV for one year (1-mrem). The overall dose range for DOE-SR cow milk samples (0.01 to 0.09-mrem) was wider than ESOP sample results due to the DOE-SR ability to detect smaller concentrations as well as the inclusion of less than MDC data (WSRC 2005). The DOE-SR goat milk dose was estimated at 0.06-mrem.

Thus, DOE-SR and ESOP environmental samples are producing approximately the same dose range for milk consumption. The increased milk dose detected by ESOP in 2004 occurred due to a first-time sample of Sr-89 in milk solids. The dominant dose in past milk sampling came from Cs-137, compared to Sr-89 in 2004. ESOP plans to continue monitoring possible radioisotope concentrations in milk solids and recommends that DOE-SR add milk solids to their sampling program.

The Liquid Pathway

ESOP Drinking Water Dose Results

Four drinking water dose values were calculated by ESOP for the 2004 liquid exposure pathway. First, a drinking water dose maximum (0.04-mrem) was calculated for drinking water customers of Beaufort/ Jasper and Port Wentworth public utilities based only on detections above an MDA. Second, a drinking water dose (0.04-mrem) was calculated for a member of the public who drank surface water from the Steel Creek and Little Hell boat landings, and River Mile 118.8 (Hwy 301). Third and fourth, the Public Water Systems groundwater wells (0.05-mrem) and the South Carolina Department of Natural Resources (SCDNR) groundwater monitoring wells (0.02-mrem) represented the potential dose that may occur in PWS wells and private wells. The groundwater dose was due mostly to an alpha average (0.04-mrem) greater than the 2004 South Carolina background average. The highest MEI water dose came from public water system wells (0.05-mrem) due to a 0.008 higher alpha than found in river water. These four different studies represented a maximum overall average dose to the public of 0.04-mrems from the liquid pathway or 1.0 % of the EPA 4-mrem drinking water standard.

The ESOP MEI was assumed to use river and boat landing water sources for drinking and cooking, and treated water from well water systems. A survivalist type of individual might consume water from the Hwy 301, Little Hell, and Steel Creek boat landing surface water sources. Free flowing artesian water is present at the Hwy 301 and Little Hell boat landings. Contamination at these Savannah River boat landing locations was possibly reduced by the influx of fresh artesian water. The maximum ESOP MEI drinking water dose from river surface water at these boat landings was 0.04-mrem. Overall, alpha contributed the largest total water dose (0.072-mrem), tritium second (0.066-mrem), and beta third (0.019-mrem).

The up-gradient public water supply wells were assumed to represent the NORM dose possible from very deep private wells (0.05-mrem). It was not unusual for private wells in some areas of

Aiken County to be drilled to a depth of 300 or more feet. These wells were deep enough to possibly accumulate dissolved NORM from up-gradient sources of saprolitic granite that occur in the aquifer recharge areas (Colquhoun 1983). Beta from the "C" wells located in Allendale County and down-gradient from the SRS contributed a total dose of 0.019-mrem to the possible MEI, which was less than the up-gradient public water supply wells. Elevated tritium levels should be the leading indicator of contamination in groundwater and none was detected above background in the SCDNR wells down-gradient of the SRS (SCDHEC 2004). The SCDNR C-6, C-7, C-10, and C-13 monitoring wells were cased to an average of 205 feet with total depths reaching over 1000 feet. Groundwater was not monitored off-SRS by the DOE-SR.

The ESOP Savannah River liquid pathway maximum dose detection was less than 0.07-mrem during the previous five years, but DOE-SR potential dose estimates were 0.09 to 0.22-mrems during that same period. ESOP composites tend to give lower sample results than grab samples due to the dilution effect of combining higher sample detections with lower sample detections. Another dilution effect was due to the increasing volume from tributary streams that occurred between the MEI drinking water location and the public water intakes that are farther downstream.

Fisherman Dose Results

The total dose above background from all fish collected by ESOP in 2004 was 0.84-mrem, and the average dose from equal consumption of the four fish species surveyed was 0.21-mrem (section 6.1.3). Bass contained the highest dose to the MEI for both radionuclides surveyed (0.006-mrem tritium and 0.429-mrem Cs-137). The MEI survivalist would probably take advantage of all edible fish. However, the highest total dose for bass (0.44-mrem) contained the maximum concentration per radionuclide detected, and represented the MEI fish consumption dose for ESOP.

ESOP used sediment data from SV-2018, SV-2019, and SV-118 that was greater than the background at SV-2010 to estimate accidental ingestion, inhalation, and direct exposure to resuspended dried sediment from stream banks (0.03-mrem). The soil, sediment, and TLD dose was used to estimate the typical external exposure (after subtracting the background) expected for the sportsman around the perimeter of the SRS (1.85-mrem). The swamp fisherman MEI fished in all locations around the perimeter of SRS.

The DOE-SR maximum off-SRS fisherman dose (0.97-mrem) was higher than that observed by ESOP (0.44-mrem). Figure 1, section 6.1.2 show the fish dose from 1999 to 2004 and illustrates that fish were the second most important contributor to the MEI dose during that period. Cesium-137 can bioaccumulate in fish and was the dominant contaminant in the DOE-SR cumulative liquid pathway (WSRC 1997, 1998). Cesium-137 releases from leaking fuel elements to the liquid pathway occurred in the 1950s and 1960s, and due to its long half-life (30.2 yrs) continues to contaminate fish today. The liquid releases show up primarily in the aquatic biota (fish and crustaceans) and sediments.

All-Pathway Dose

The DOE-SR All-Pathway dose excludes the sportsman dose and refers to the combined air and liquid doses from inhalation of air particulates and ingestion of water near the site boundary. These combined dose estimates are much less than the dose received from watching TV for one year (1-mrem). An ESOP drinking water dose maximum (0.04-mrem) was calculated for drinking water customers of Beaufort/ Jasper and City of Savannah public utilities. The four possible drinking water sources (PWS river water, PWS wells, GW wells, and boat landings) would give an average of 0.035-mrem for potable and non-potable water sources. The DOE-SR drinking water results (0.03-mrem avg) and the ESOP results indicated that the public potable water radiation exposure should average 0.04-mrem/yr. The ESOP MEI who drank untreated river water near Savannah River boat landings would have received 0.04-mrem or 1% of the DOE standard.

The ESOP air data was <0.01-mrem. The DOE-SR all-pathway dose was based on the MEI near the SRS boundary. The ESOP MEI All-Pathway detected maximum dose (liquid plus air) was <0.06-mrem compared to the DOE-SR calculated dose estimate of 0.15-mrem. Thus, DOE-SR calculated estimates for public dose exposure continue to be conservative.

Sportsman Pathway

Both the fish median and average were greater than the deer average dose for the non-MEI statistics (based on averages only). However, the MEI statistics (based on a maximum dose received by a single hunter instead of an average dose) reverse this trend and deer become the dominant dose contributor. Figures 1 and 2, section 6.1.2 show that a trend change can occur when a maximum deer dose was substituted for an average deer dose. Soil exposure was the third highest media contributor to average dose for ESOP in 2004 (Table 2, section 6.1.2), while fish and deer alternated between first and second in the previous 4 years average dose. Deer always replaced fish as the number one dose contributor when the MEI maximum doses were compared. Compare the 2004 ESOP MEI 15.75-mrem deer consumption maximum dose to the 0.84-mrem average deer dose, and the 0.44-mrem fish dose. ESOP dose calculations are based on actual field data and tend to be less than the conservative DOE-SR off-SRS MEI deer dose estimates (17.30-mrem). The DOE-SR used a computer model to estimate the dose values to the MEI from the sportsman exposure pathway. The DOE-SR MEI calculation for fish was based on the fish sample with the highest concentration. ESOP based its own fish MEI on the total of the highest radioisotope concentrations, irrespective of species, since the MEI eats all types of fish.

Deer consumption (on an average dose basis) was the highest media contributor to average dose for ESOP in 2004 (Table 2, section 6.1.2). Deer always replaced fish as the number one exposure media when the dose estimate was based on a single hunter's consumption of deer (Figure 2, section 6.1.2) instead of an average deer dose.

The three main routes of dose exposure to the sportsman were ingestion, direct external absorption, and inhalation. Food was the main pathway of dose exposure (Table 1, section 6.1.2) for the swamp dwelling MEI who resided downriver below the SRS swamp, killed and ate deer, caught and ate fish from the SRS stream mouths, drank milk, and grew some vegetables locally.

The 2004 ESOP highest MEI food pathway dose was deer (85.7%), fish (2.4%), milk (1.0%), and vegetables (0.06%). The combination of ground exposure factors with MEI deer and fish consumption for the ESOP sportsman MEI (18.38-mrem) was lower than the DOE-SR (22.24-mrem) estimates in 2004. This comparison excluded the DOE-SR feral hog data, since ESOP did not sample feral hogs in 2004.

The dominant dose by radioisotope is given in section 6.1.3, with Cs-137, alpha, H-3, and beta-gamma providing over 95% of the dose (1999-2004). Figure 1 represents the average dose above background detected in sample media collected for the ESOP perimeter survey of the SRS from 1999 through 2004. The highest concentrations for each radioisotope, irrespective of species, were added to represent the maximum possible dose for the media (e.g. fish). Historically, ESOP MEI deer consumption (82.04%) contributed the highest overall dose from 1999 through 2004 followed by fish (5.02%), soil (2.69%), milk (0.60%), ingestion of surface water (0.53%), TLD (0.42%), groundwater (0.40%), river water 0.29(%), consumption of edible vegetation (0.03%), and inhalation of air (0.03%).

The average non-MEI sportsman exposure (Table 2 and Figure 2, section 6.1.2) showed a different trend than the MEI sportsman, with fish (0.44-mrem) and deer (0.84-mrem) taking second place to soil (1.62-mrem). The game pathway (1.32-mrem) was second to soil, but contributed far more to the average dose exposure than the atmospheric and liquid pathways combined (<0.06-mrem).

The highest radioisotope exposure in 2004 came from a possible soil alpha ingestion assigned to Pu-239 (1.19-mrem). The second highest was Cs-137 in deer and fish, and Sr-89 was third (milk solids).

During the past five years, the dose to the MEI for fish has been <1-mrem for both organizations (Figure 3, section 6.1.2). The difference between the ESOP detections and the DOE-SR estimates was possibly due to the methods of calculating the dose value. The ESOP used actual data collected from the field, while the DOE-SR used a computer model based on the radionuclide levels in on-SRS deer to calculate a MEI dose exposure value for off-SRS deer. The deer MEI dose value has varied greatly during the past four years possibly due to numerous diet and weather related factors (resuspension and deposition of radionuclides). The low DOE-SR dose in 2001 was due to the limited number of hunts conducted after the September 11, 2001 terrorist attack (WSRC 2002).

Factors influencing dose estimates included fluctuation of the deer and fish populations due to disease, predation, and available food. Deer, for example, consume certain types of edible mushrooms when available (Du Pont 1983). Mushrooms are the number one bioconcentrator of some heavy metals and radioisotopes (Botsch 2000, Kalac 2001). The availability of these mushrooms may be determined by factors that enhance or reduce radionuclide concentrations (e.g. controlled burns, deforestation, and weather). It may be possible in the future to correlate Cs-137 peak concentrations that occur in mushrooms and deer with weather and resuspension activities. Dry weather conditions are not favorable to the growth of mushrooms.

Figure 3 illustrates that the MEI dose trend for fish and deer were similar for both ESOP and DOE-SR from 1999 to 2003. Other game animals (feral hogs) have been harvested, but ESOP does not have hog data (except for 2002) to compare with the DOE-SR hog data. Past

DOE-SR data and ESOP data indicated that hogs are a major game animal contributor to the MEI dose. The 2004 detected average dose from actual off-SRS deer samples (ESOP samples) were low (0.84-mrems) compared to the estimated off-SRS average deer dose by DOE-SR (17.3-mrem). Also, the 2004 ESOP survivalist-sportsman MEI scenario gave a total dose of 18.38-mrem that did not include off-SRS feral hogs (8.67-mrem estimate by DOE-SR). Thus, the potential dose can be higher (27.04-mrem) than that cited for the survivalist-sportsman MEI comparison. The potential MEI dose could be even higher, if other game were included. The worst-case scenario estimations by the DOE-SR were usually conservative since the ESOP average deer sample dose per year was many times smaller (section 6.1.2). The MEI deer hunter maximum exposure was always several times higher than the average deer dose, which means that a small sample set using the maximum detection would still provide a conservative estimate of dose to the average deer hunter.

Deer Meat Dose Results

The DOE-SR off-SRS deer dose was estimated from the on-SRS deer dose, and represented a maximum that would not be expected from off-SRS deer on an average basis. The DOE-SR total off-SRS estimated deer dose was 17.3-mrem based on the average Cs-137 in all deer and not the maximum detected dose. The higher on-SRS average deer dose estimate (70.8-mrem) versus the lower off-SRS average detected dose (15.8-mrem) may be due to the available food in each habitat, and the contamination contained in that vegetation. The average of the DOE-SR estimated off-SRS dose (17.3-mrem) and the ESOP observed off-SRS (15.75-mrem) dose for the consumption of deer in 2004 was 16.53-mrem. Again, this was less than the average exposure from cosmic radiation in one year (26-mrem).

Total MEI Dose

The DOE-SR data for the MEI came from the SRS Environmental Report for 2004 (WSRC 2005). Table 2, section 6.1.2 shows similar media and pathway doses that were used to compare the ESOP survivalist-sportsman MEI scenario with DOE-SR MEI potential dose data. Table 1, section 6.1.2 totals are different than the Table 2, section 6.1.2 totals, since only the highest applicable dose was used for the MEI survivalist-sportsman scenario in Table 1, section 6.1.2, and the average dose was used in Table 4. The total dose for the swamp dwelling survivalist-sportsman MEI who consumed the maximum deer dose was 18.38-mrem. The exposure to the average sportsman consuming the average deer dose was only 3.47-mrem. The averages of comparable media doses in Table 2, section 6.1.2, 4.57-mrem (ESOP) and 5.87-mrem (DOE-SR), were within one standard deviation of each other. This demonstrates that the two programs were detecting similar environmental data. However, the large standard deviation in comparison to the average may indicate that more data or sampling was needed. Alternately, a high standard deviation may simply represent a highly variable environmental parameter for a particular media. The median may be a better indicator of the dose central tendency in highly variable environmental data. Thus, the typical exposure for a member of the general public who was a sportsman may be less than the 1.73-mrem median, which is the average of the ESOP and DOE-SR medians (Table 2, section 6.1.2).

The food pathways dominate the dose to the swamp dwelling MEI, and either the deer or fish dose may dominate in a particular year on an average dose basis. The primary cause of this fluctuation was apparently due to the variability in deer radionuclide concentration. Generally, the liquid and air dose routes contribute less than 0.03 % of the dose to the average sportsman from 1999 to 2004 (section 6.1.3). The DOE-SR potential air dose from Table 2, section 6.1.2 is 0.6% of the DOE 10-mrem air standard. The DOE-SR potential liquid dose is 2.25 % of the EPA 4-mrem drinking water standard. The total ESOP MEI detected dose for the survivalist-sportsman scenario from all pathways (approximately 18.38-mrem) gives a dose that is 18.38% of the 100-mrem DOE standard for allowable dose to the public and environment.

The ESOP detected air dose was only 0.002-mrem compared to the DOE-SR calculated potential air dose of 0.06-mrem, which indicated that depositions of the possible DOE-SR aerial contamination within the 50-mile SRS perimeter were minimal. Thus, most of the aerial depositions were either very close to the release stacks or outside of the SRS perimeter.

The ESOP calculated total dose (mrem/yr) to the MEI for the past five years is shown in Figure 1, section 6.1.2 and section 6.1.3. The MEI dose became highly variable when the game animal dose was added. The greatest difference between ESOP and DOE-SR average dose results occurred in the game animal pathway (ESOP 15.75-mrem, DOE-SR 17.3-mrem). The DOE-SR off-SRS deer dose estimate was based on on-SRS deer moving off-SRS. Comparatively, the ESOP used only detected data collected from actual monitoring activities to establish dose for the detected radioisotopes. DOE-SR used all calculated data per DOE approved procedures whether negative or less than an MDC. The actual ESOP off-SRS deer dose was 91.0% of the DOE-SR estimated off-SRS deer dose. Thus, the DOE-SR dose estimates were not overly conservative. The similarity (within one standard deviation) of the average dose estimates for the ESOP (4.57-mrem) and DOE-SR (5.87-mrem) comparable media data (Table 2, section 6.1.2) seems to indicate that the two programs are accurately detecting the overall dose exposure to the public.

When comparing the total dose to the MEI from SRS operations, it is important to be aware of the total dose received each year from naturally occurring radiation. Figure 4, section 6.1.2 depicts the average total doses received each year by everyone living in the Southeastern Region of the U.S. (composite from SCDHEC 2005 website and 2001 SRS Environmental Report). The ESOPMEI received 18.38-mrem in 2004, which was less than that received by the individual through exposure to cosmic radiation (26-mrem).

6.1.2 Tables and Figures
Radiological Dose Calculation

Table 1. 2004 ESOP Dose Estimates for Exposure Routes, Pathways, and Media

Inhalation	Air		Air	0.00
1.1% of Dose	Resuspended Soil		flag - see note 8.	0.19
	Resuspended Sediment			0.00
	Total Dose - Air Inhalation (1.1% of Dose)			**0.19**
Ingestion	Food		Fish	0.44
96.5% of Dose			Deer avg (0.84-mrem)	15.75
			Hog	NS(9)
			Vegetable	0.01
			Milk	0.18
	Total Dose - Food Ingestion (90.2% of Dose)			**16.38**
	Water	Potable	River	0.04
			PWS (1) Wells (MEI)	0.05
			DNR (2) Wells	0.02
		Nonpotable	Swamp/RW (3)	**0.04**
	Soil		Soil (flag - see note 8).	1.19
	Sediment		Sediment	0.03
	Total Dose-DW (4) Ingestion (7.3% of Dose)			**1.37**
Direct Exposure	Air	Cloud	Submersion	0.00
2.4% of Dose		Skin	Absorption	0.00
	Water	Swimming	Immersion	0.00
		Skin (5)	Absorption	0.00
	Soil	Ground	Shine (flag - see note 8).	0.19
		TLD (7)	Absorption	0.25
	Sediment	Shoreline	Shine	0.00
	All Direct MEI (6) Exposure (2.4% of Dose)			**0.44**
Total MEI (6) Offsite Dose - Food, Water, and Air Pathways				**18.38**

Notes:
1. PWS is public water system.
2. DNR is the Department of Natural Resources.
3. Swamp/RW is the swamp dweller survivalist who uses rainwater and riverwater.
4. DW is water used as potable drinking water after treatment.
5. Skin absorption includes photons from boating.
6. MEI is the maximally exposed individual who is a river/swamp dweller.
7. TLD is thermoluminescent dosimeter.
8. Samples lying in depositional flood plains downstream of piedmont saprolitic granite.
9. NS is no sample in 2004.

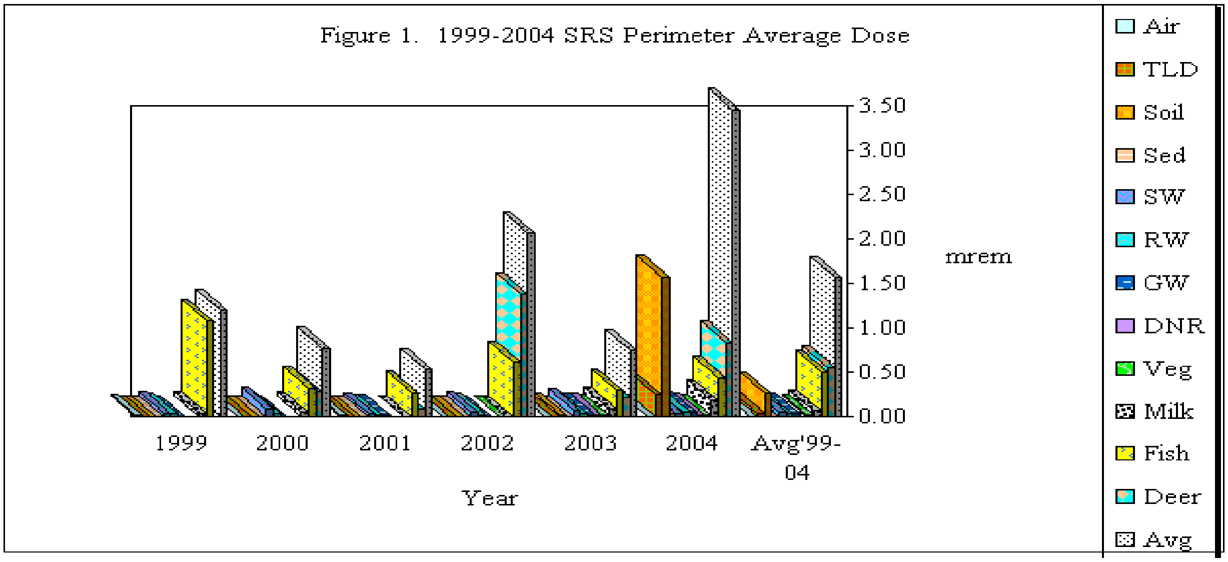
Tables and Figures
Radiological Dose Calculation

Table 2. ESOP and DOE-SR Dose Results for Survivalist-Sportsman Maximally Exposed Individual (MEI)

Environmental Monitors - 2004		**SCDHEC**				**DOE-SR** (1)		
Pathways - - - - - - - Media (below)	**Air**	**Liquid**	**Soil**	**Food**	**Air**	**Liquid**	**Soil**	**Food**
Water		0.05				0.09		
Inhalation* (7)	0.00				0.06			
Combined Soil* (3,8)			1.85				4.94	
Swimming		0.00				0.00		
Boating		0.00				0.00		
Milk				0.18				0.06
Edible Vegetation				0.01				0.04
Creek Mouth Fish				0.44				0.97
Offsite Deer				15.75				17.30
Totals	0.00	0.05	1.85	16.38	0.06	0.09	4.94	18.37
Median		0.00		0.31		0.00		0.52
2003 MEI Comparison	**Pathways**				**Summary Statistics**			
Totals	**Air**	**Liquid**	**Soil**	**Food**	**Totals**	**Avg.**(4)	**sd** (5)	**Median**
SCDHEC	0.00	0.05	1.85	16.38	18.28	**4.57**	7.92	0.95
DOE-SR	0.06	0.09	4.94	18.37	23.46	**5.87**	8.65	2.52
Averages and Median	**0.03**	**0.07**	**3.40**	**17.37**	**20.87**	**5.22**	**8.28**	**1.73**
Standard Deviation	0.04	0.03	2.18	1.41	3.66	0.92	0.51	1.11
% of standard (6)	**0.30**	**1.75**						

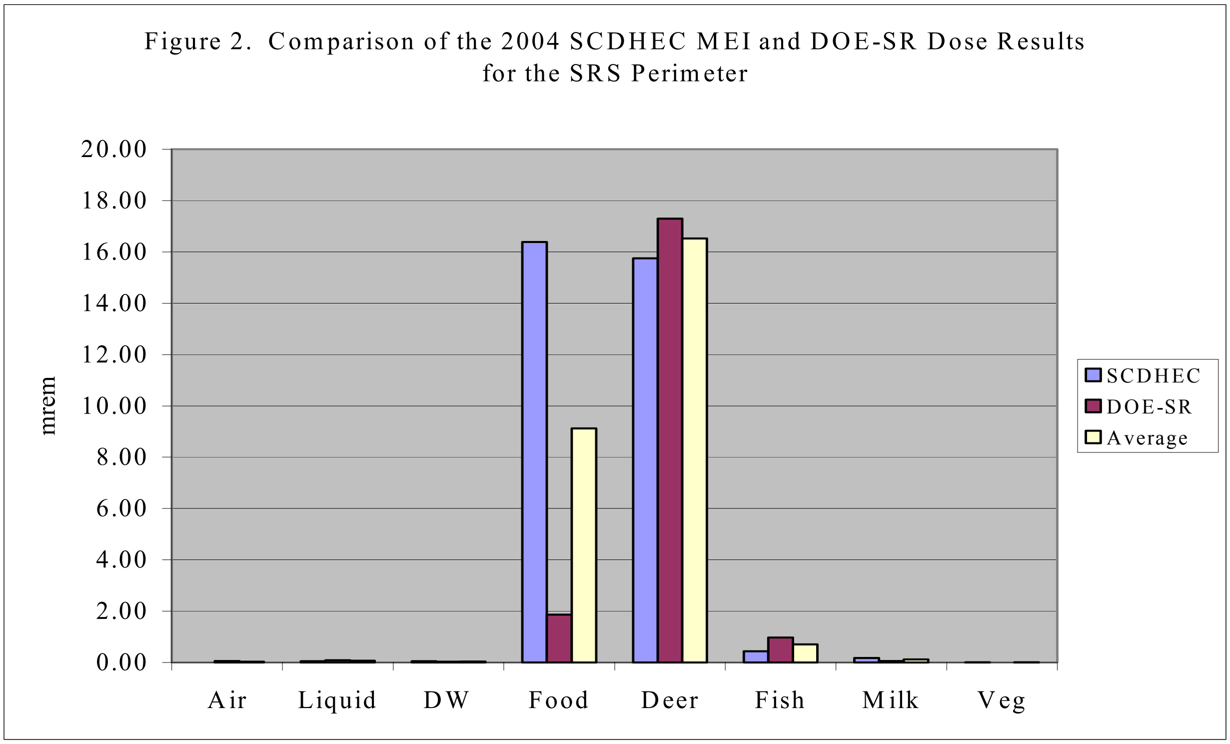
Notes:
1. The DOE-SR estimates of dose to the MEI come from the Savannah River Site Environmental Report for 2004, WSRC-TR-2005-00005.
2. All dose results not shown were well outside the significant figure standard.
3. The combined soil reflects dose from swamp and creek bank soil.
4. Avg is average.
5. sd is standard deviation.
6. % is percent of EPA and DOE air (10-mrem) and liquid (4-mrem) standards.
7. Inhalation from resuspended soil was included in the SCDHEC soil category, since inhalation of resuspended soil was not likely in flood plain soil.
8. The SCDHEC combined soil category included ingestion, direct exposure, and resuspension inhalation of soil and direct exposure detected by TLD.

Tables and Figures
Radiological Dose Calculation



Notes: The above data are in millirem per year and based on data section 6.1.3.
1. “RW” is public water systems using river water.
2. “GW” is public water systems using groundwater.
3. “SW” is surface water.
4. “DNR” is the Department of Natural Resources monitoring wells.
5. “Sed” is sediment.
6. “Veg” is vegetation.
7. TLD is the direct exposure above background detected by thermoluminescent dosimeters.
8. The deer results in Figure 1 were based on an overall average dose minus an average background dose, whereas the MEI deer results in Figure 2 were based on a maximum deer dose being consumed by one individual.
9. The “Avg ’99-04” is the average dose for that media for the period 1999-2004, whereas the “Avg” represents the average for all media in a given year.

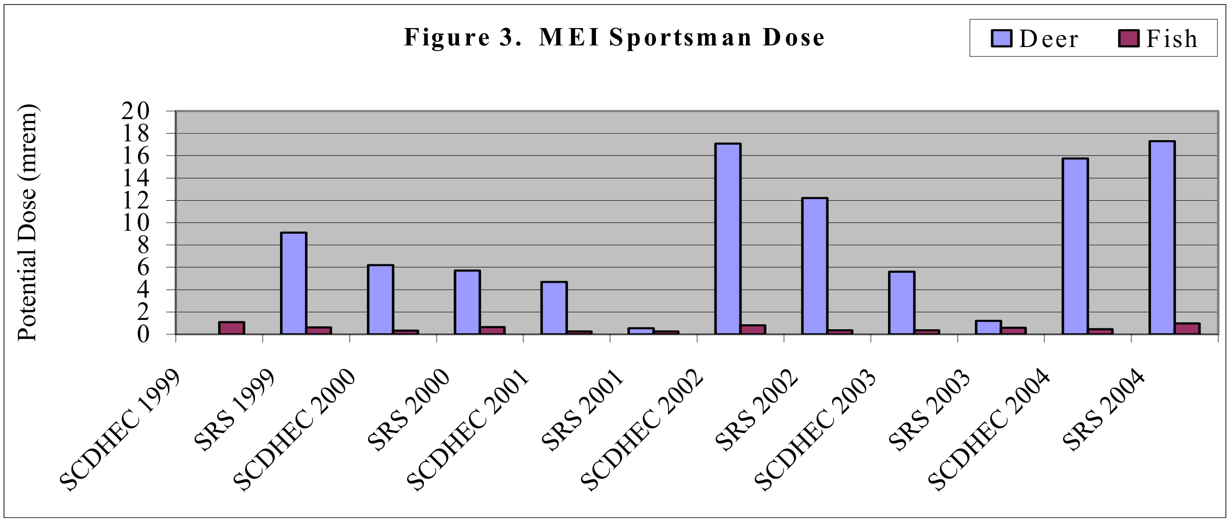
Tables and Figures
Radiological Dose Calculation



Notes:

1. The liquid pathway refers to the maximally exposed individual at the SRS boundary whereas DW refers to the drinking water average exposure at public water supplies downriver from the SRS.
2. The Figure 2 MEI deer results were based on a single maximum dose for one hunter, whereas the deer results in Figure 1 were based on an overall average dose above background for deer.

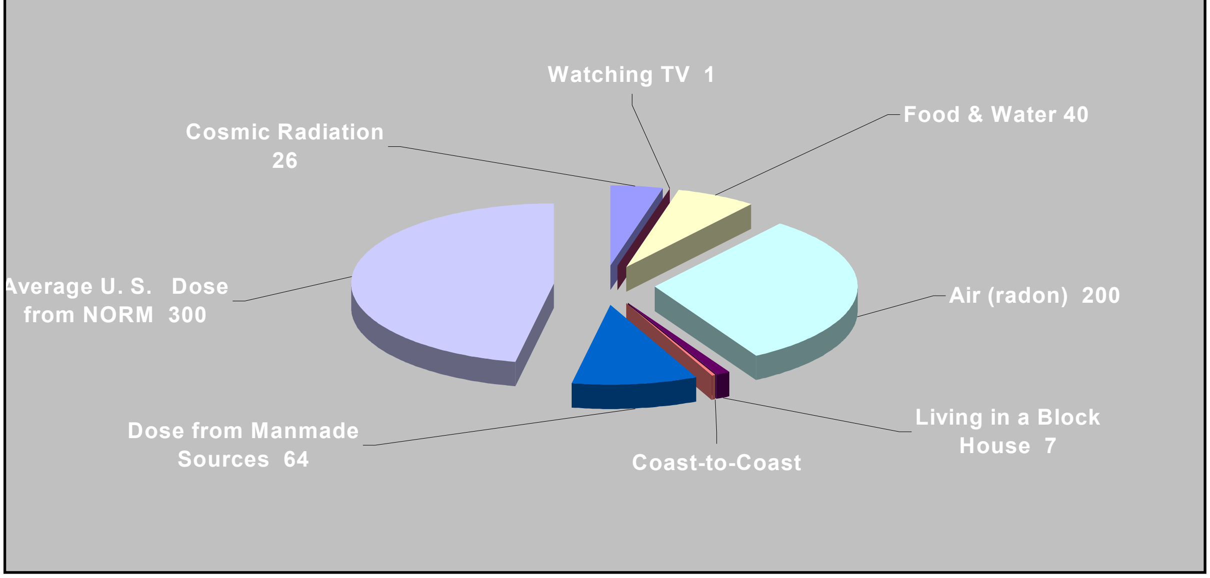
Tables and Figures
Radiological Dose Calculation



Notes:
1. When DOE-SR (SRS) showed a trend change, ESOP did also.
2. Three trends are illustrated, two decreasing from initial high doses in 1999 and 2002, and one new high dose in 2004. If the trend repeats, then 2005 should show a decrease in 2005.
3. “Mrem” is milliroentgen equivalent man dose unit.
4. “MEI” is the maximally exposed individual who consumed fish and deer.
5. Reference WSRC reports and data from 1999 through 2004.

Tables and Figures
Radiological Dose Calculation

Figure 4. Comparison of Dose Levels (mrem/yr)



Notes:
1. Composite of dose levels established by the USEPA and the SRS Environmental Report for 2001. These pie sections are relative to dose only.

6.1.3 Data
Radiological Dose Calculation Data

Radiological Dose Calculation Data

1999 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	**mrem**	mrem	**1.08**
Ingestion	H-3	4.97	0.00	4.97	48.2	0.015	1.075	
	Cs-137	0.44	0.00	0.44	48.2	1.060		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	**mrem**	mrem	**0.04**
Ingestion	H-3	3.850E-02	0.00	3.850E-02	230	0.001	0.043	
	Cs-137	3.670E-03	0.00	3.670E-03	230	0.042		
	Sr-90	7.200E-04	2.270E-03	0.00	230	-0.004		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	**mrem**	mrem	
RW Ingestion	H-3	933.67	258	675.67	730	0.032	0.032	
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	**mrem**	mrem	**0.01**
Inhalation	H-3	0.000	4.350	-4.35	8000	-0.002	0.010	
	Alpha	0.000	0.004	0.00	8000	-9.379		
	Beta	0.000	0.020	-0.02	8000	-0.208		
	Sr-89,90	0.001	0.000	0.00	8000	0.009		
	U-234	0.000	0.000	0.00	8000	0.000		
	U-238	0.000	0.000	0.00	8000	0.001		
TLD		mrem	mrem	mrem	hrs/day	**mrem**	mrem	**0.00**
Direct Exposure		0.182	0.198	0.00	24	0.000	0.000	
Soil		pCi/g	pCi/g	pCi/g	mg/day	**mrem**	mrem	**0.00**
Ingestion	Cs-137	0.73	0.19	0.54	100	0.001	0.001	
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	**mrem**	mrem	**0.04**
Swimming Ingestion &	H-3	1054	238	816.00	27	0.000	0.038	
Exposure	Alpha	0.45	1.59	0.00	27	0.000		
	Beta	0.00	2.86	0.00	27	0.000		
	Cs-137	0.00			27	0.000		
Boating Exposure	H-3	1054	238	816.00	63	0.000	0.000	
	Alpha	0.45	1.59	0.00	63	0.000		
	Beta	0.00	2.86	0.00	63	0.000		
	Cs-137	0.00			63	0.000		
		pCi/L	pCi/L	pCi/L	L/yr	mrem		
Ingestion	H-3	1054	238	816.00	730	0.038		
(MEI Drinking Water)	Alpha	0.45	1.59	0.00	730	0.000		
	Beta	0.00	2.86	0.00	730	0.000		
	Cs-137	0.00			730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	**mrem**	mrem	**0.00**
Shoreline	Cs-137	0.54	0.035	0.51	67	0.000	0.000	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	**mrem**	mrem	**0.00**
	H-3	305	363	0.00	730	0.000	0.000	
	Alpha	0.00	4.88	0.00	730	0.000		
	Beta	0.00	8.46	0.00	730	0.000		
					MEI Radiation Dose			**1.17**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI dose includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2000 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.32**
Ingestion	H-3	2.51	0.00	2.51	48.2	0.0078	0.320	
	Cs-137	0.13	0.00	0.13	48.2	0.313		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.05**
Ingestion	H-3	3.820E-02	0.00	3.820E-02	230	0.001	0.054	
	Cs-137	4.600E-03	0.00	4.600E-03	230	0.053		
	Sr-90		2.270E-03	0.00	230	0.000		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	918	258	660.00	730	0.031	0.031	
	Alpha	2.76	3.50	0.00	730	0.000		
	Beta	0.000	2.84	0.00	730	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**LE**
Inhalation	H-3	0.000	4.350	-4.35	8000	-0.002	**LE**	
	Alpha	0.000	0.004	0.00	8000	-9.379		
	Beta	0.001	0.020	-0.02	8000	-0.198		
	Sr-89,90	0.000	0.000	0.00	8000	0.000		
	U-234	0.000	0.000	0.00	8000	0.000		
	U-238	1.070E-05	0.000E+00	0.00	8000	0.010		
TLD		mrem	mrem	mrem	hrs/day	mrem	mrem	**0.00**
Direct Exposure		0.181	0.198	0.00	24	0.000	0.000	
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	
Ingestion	Pu-239/240	0.05	0.02	0.03	100	0.001	0.001	**0.00**
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.09**
Swimming Ingestion &	H-3	995.54	238	757.54	27	0.000	0.091	
Exposure	Alpha	2.78	1.59	1.19	27	0.003		
	Beta	3.74	2.86	0.88	27	0.000		
	Cs-137	0.00			27	0.000		
Boating Exposure	H-3	995.54	238	757.54	63	0.000		
	Alpha	2.78	1.59	1.19	63	0.000		
	Beta	3.74	2.86	0.88	63	0.000		
	Cs-137	0.00			63	0.000		
		pCi/g	pCi/g	pCi/g	L/yr	mrem		
Ingestion	H-3	995.54	238	757.54	730	0.035		
(MEI Drinking Water)	Alpha	2.78	1.59	1.19	730	0.045		
	Beta	3.74	2.86	0.88	730	0.008		
	Cs-137	0.00			730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0.00**
Shoreline	Cs-137	0.275	0.035	0.24	67	0.000	0.000	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	390	363	27.0	730	0.001	0.001	
	Alpha	0.00	4.88	0.00	730	0.000		
	Beta	0.00	8.46	0.00	730	0.000		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	1.01		0.73		0.280	0.280	
MEI Deer Ingestion	Cs-137	**Maximum Single Hunter Consumption**					6.2	**6.20**
					MEI Radiation Dose			**6.66**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI dose includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2001 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.27**
Ingestion	H-3	0.78	0.00	0.78	48.2	0.0024	0.267	
	Cs-137	0.11	0.00	0.11	48.2	0.265		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0**
Ingestion	H-3	0.000	0.00	0.00	230	0.000	0.000	
	Cs-137	0.000	0.00	0.00	230	0.000		
	Sr-90	0.000	2.270E-03	0.00	230	-0.006		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	539	258	281.00	730	0.013	0.013	
	Alpha	0.000	3.50	0.00	730	0.000		
	Beta	0.000	2.84	0.00	730	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**0.01**
Inhalation	H-3	0.19	4.350	-4.16	8000	-0.002	0.006	
	Alpha	0.002	0.004	0.00	8000	-4.443		
	Beta	0.000	0.020	-0.02	8000	-0.208		
	U-234	0.000	0.000	0.00	8000	0.000		
	U-238	2.130E-06	0.000E+00	0.00	8000	0.002		
	Am-243	3.100E-06	0.000E+00	0.00	8000	0.003		
TLD		mrem	mrem	mrem	hrs/day	mrem	Perimeter TLD	**0**
Direct Exposure		40.480	46.700	-6.22	24	0.000		
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	**0**
Ingestion	Pu-238	1.840E-02	0.00	1.840E-02	100	0.001	0.002	
	Pu-239/240	3.840E-02	2.000E-02	1.840E-02	100	0.001		
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.03**
Swimming Ingestion &	H-3	934.4	238	696.40	27	0.000	0.033	
Exposure	Alpha	0.54	1.59	0.00	27	0.000		
	Beta	0.88	2.86	0.00	27	0.000		
Boating Exposure	H-3	934.4	238	696.40	63	0.000		
	Alpha	0.54	1.59	0.00	63	0.000		
	Beta	0.88	2.86	0.00	63	0.000		
	pCi/L	pCi/L	pCi/L	pCi/L	L/yr	mrem		
Ingestion	H-3	934.4	238	696.40	730	0.033		
(MEI Drinking Water)	Alpha	0.54	1.59	0.00	730	0.000		
	Beta	0.88	2.86	0.00	730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0**
Shoreline	Alpha	9.15	9.48	0.00	67	0.000	0.000	
	Beta	4.83	25.8	0.00	67	0.000		
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	0.00	363	0.00	730	0.000	0.013	
	Alpha	8.32	4.88	3.44	730	0.013		
	Beta	2.08	8.46	0.00	730	0.000		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	1.25		1.17		0.080	0.080	
MEI Deer Ingestion	Cs-137	**Maximum Single Hunter Consumption**				0.000	4.7	**4.7**
						MEI Radiation Dose		**5.01**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI dose includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2002 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.61**
Bass Ingestion	H-3	1.04	0.00	1.04	48.2	0.003	0.606	
	Cs-137	0.25	0.00	0.25	48.2	0.603		
Catfish Ingestion	H-3	0.41	0.00	0.41	48.2	0.001	Species Average	
	Cs-137	0.08	0.00	0.08	48.2	0.193	0.202	
Bowfin Ingestion	H-3	0.29	0.00	0.29	48.2	0.001		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.00**
Ingestion	H-3	0.0123	0.0000	0.0123	230	0.000	0.000	
	Cs-137	0.0000	0.0000	0.0000	230	0.000		
	Sr-90	0.0000	0.0023	0.0000	230	0.000		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	706	258	448.00	730	0.021	0.021	
	Alpha	0.00	3.50	0.00	730	0.000		
	Beta	0.00	2.84	0.00	730	0.000		
Edible Vegetation		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.00**
Ingestion	H-3	0.137	0.379	0.00	73	0.000	0.000	
	Cs-137	0.00	1.11	0.00	73	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**0.00**
Inhalation	H-3	1.48	4.350	0.00	8000	0.000	0.000	
	Alpha	0.001	0.004	0.00	8000	-6.911		
	Beta	0.001	0.020	0.00	8000	0.000		
TLD		mrem	mrem	mrem	hrs/day	mrem	mrem	**0.00**
Direct Exposure		45.710	56.090	0.00	24	0.000	0.000	
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	**0.00**
Ingestion	Sr-89	0.00	0.00	0.00	100	0.000	0.000	
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.05**
Swimming Ingestion &	H-3	810	238	572.00	27	0.000	0.050	
Exposure	Alpha	2.16	1.59	0.57	27	0.001		
	Beta	0.00	2.86	0.00	27	0.000		
Boating Exposure	H-3	810	238	572.00	63	0.000		
	Alpha	2.55	1.59	0.96	63	0.000		
	Beta	0.00	2.86	0.00	63	0.000		
Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem		
(MEI Drinking Water)	H-3	810	238	572.00	730	0.027		
	Alpha	2.16	1.59	0.57	730	0.022		
	Beta	0.00	2.86	0.00	730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0.00**
Shoreline	Cs-137	1.225	0.035	1.19	67	0.000	0.000	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	0.00	363	-363.00	730	-0.017	0.000	**0.00**
	Alpha	2.45	4.88	-2.43	730	-0.092		
	Beta	2.42	8.46	-6.04	730	-0.053		
	Ra-226	0.959	4.88	-3.92	730	-3.795		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	2.43		1.05		1.380	**1.380**	
MEI Hog Ingestion	Cs-137	4.77		0.00			**4.770**	**4.77**
MEI Deer Ingestion	Cs-137	**Maximum Single Hunter Consumption**					**17.100**	**17.10**
					MEI Radiation Dose			**22.53**

Notes: see the glossary section for radionuclide information.

*Alpha data calculated as Pu-239

*Beta data calculated as Sr-90

*MEI includes surface water instead of drinking water.

*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only in Food Sources

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose
Food Sources							**Average Dose**	**Total mrem/species**	
Fish Ingestion		**pCi/g**	**pCi/g**	**pCi/g**	**kg/yr**	**mrem**	**Fish mrem avg/rad**	Bass	**0.30**
Bass	H-3	0.911	0.000	0.911	48.2	0.003	tritium avg dose	0.300	
	Cs-137	0.1233	0.0000	0.1233	48.2	0.297	0.002	Catfish	
				Bass	Avg	0.150		0.164	
Catfish	H-3	0.446	0.000	0.446	48.2	0.001	Cs-137 avg dose	Spotted Sucker	
	Cs-137	0.0675	0.0000	0.0675	48.2	0.163	0.218	0.195	
				Catfish	Avg	0.082		Fish Total Detect Dose	
Spotted Sucker	H-3	0.586	0.000	0.586	48.2	0.002		0.659	
	Cs-137	0.0801	0.0000	0.0801	48.2	0.193		Fish Average Dose	
				Sucker	Avg	0.097		0.220	
		Average Radionuclide Dose					0.110		
Milk Ingestion		**pCi/g**	**pCi/g**	**pCi/g**	**kg/yr**	**mrem**	**Milk mrem avg/rad**	**Milk Maximum Dose---**	**0.09**
Cow	H-3	0.327	0.000	0.327	230	0.005	tritium	Total mrem/species	
	Sr-90	0.001	0.000	0.001	230	0.003	0.005	Cow	
				Cow	Avg	0.004	cesium-137	0.008	
Goat		pCi/g	pCi/g	pCi/g	kg/yr	mrem	0.069	Goat	
	H-3	0.301	0.000	0.301	230	0.004	strontium-89	0.087	
	Cs-137	0.006	0.000	0.006	230	0.069	0.014	Milk Total Dose	
	Sr-89	0.006	0.000	0.006	230	0.014	strontium-90	0.095	
				Goat	Avg	0.029	0.003	Milk Average Dose	
		Average Radionuclide Dose					0.023	0.048	
Game Animal		**Average**		**Average Bkg**					
Ingestion		**Dose/Animal**		**Dose/Animal**					
		mrem		**mrem**		**mrem**	**Deer Avg Dose**	**Average Ingested Dose**	
Average Deer	Cs-137	1.59		1.38		0.21	0.21	0.21	
MEI Deer	Cs-137	**Maximum Single Hunter Consumption**							**5.60**
Edible Vegetation		**pCi/g**	**pCi/g**	**pCi/g**	**kg/yr**	**mrem**	**Veg Avg Dose**	**Edible Veg Total Dose**	
Vegetable Fruit	H-3	0.446	0.000	0.446	287.0	0.008	0.008	0.01	**0.01**
						MEI Food Dose			**6.00**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only in Water Sources

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Water Sources							**Average Dose**	**Total Dose (mrem)**	
PWS RW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	**DW mrem avg/rad**	**River Water PWS Supply**	**0.03**
Potable	H-3	573	277	296	730	0.014	Tritium (H-3)	0.029	
	Alpha	1.60	1.57	0.0	730	0.001	0.015		
	Beta	6.08	4.47	1.61	730	0.014	Alpha		
	PWS River Water Average Dose				Avg	0.010	0.001		
PWS GW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	**Beta**	**Groundwater PWS Wells**	**0.02**
Potable	H-3	357	4	353	730	0.017	0.007	0.017	
	Alpha	4.24	4.88	-0.64	730	0.000			
	Beta	2.03	6.47	-4.44	730	0.000	DW Avg Dose	PWS Total Dose	
	PWS Well Water Average Dose				Avg	0.006	0.008	0.046	
	Used Aiken State Park C-3 wells as background.							PWS Avg Dose	
	Used tritium natural isotopic ratio as background.							0.023	
DNR GW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	**All GW - Tritium Avg**	**DNRGW NORM Ttl Dose**	**0.02**
Potable	H-3	335	4	331	730	0.015	0.016	1.181	
	Alpha	3.04	4.88	-2	730	0.000			
	Beta	3.13	6.47	-3	730	0.000			
	U-238	0.484	0.217	0.2670	730	0.005	NORM	DNR MEI Dose (H-3)	
	Ra-226	1.132	0.000	1.1320	730	1.096	NORM	0.016	
	Ra-228	1.867	1.790	0.0766	730	0.080	NORM	Total Potable Plus NORM	
	DNR Wells Average Dose				Avg	0.199		1.242	
GW & DNR	Groundwater Average Dose				Avg	0.102		Avg Potable with NORM	
Potable Water Dose Average						0.072		0.414	
Water Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	**Nonpotable**	**Surface Water Near SRS**	
SR Boat	H-3	1718	313	1405	730	0.066	Average Dose		
Landings	Alpha	1.659	1.625	0.034	730	0.001	0.017	Nonpotable Ttl. MEI Dose	**0.07**
Nonpotable	Beta	2.552	2.334	0.218	730	0.002		0.068	
Rainwater	H-3	182.000	197.000	-15.000	730	-0.001			
Nonpotable Surface Water Average Dose					**Avg**	**0.017**		**Drinking Water Sources**	
								Avg MEI Water Dose	**0.04**
							MEI Drinking Water Dose (Highest)		**0.07**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only For Soil, Air, and Surface Water

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Surface Soil Ingestion		pCi/g	pCi/g	pCi/g	mg/day	mrem	**Total Soil Ingestion**		0.00
	Pb-212	0.6010	0.5840	0.0170	100	0.0000	Gamma Avg Dose	Gamma Total Dose	
	Mn-54	0.0160	0.0000	0.0160	100	0.0000	0.0002	0.0010	
	Cs-137	0.1800	0.1740	0.0060	100	0.0000			
	Ce-144	0.2650	0.0000	0.2650	100	0.0002			
	Tc-99	5.1600	0.0000	5.1600	100	0.0003			
Sediment	Cs-137	0.3070	0.0294	0.2776	100	0.0005			
	Surface Soil Ingestion Average Dose				Avg	0.0002			
Surface Soil Exposure		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	**Total Soil Direct Exposure**		0.02
Direct Exposure	Pb-212	0.6010	0.5840	0.0170	4380	0.0023	Gamma Avg Dose	Gamma Total Dose	
	Cs-137	0.1800	0.1740	0.0060	4380	0.0000	0.0035	0.0209	
	Mn-54	0.0160	0.0000	0.0160	4380	0.0144			
	Ce-144	0.2650	0.0000	0.2650	4380	0.0038			
	Tc-99	5.1600	0.0000	5.1600	4380	0.0002			
Sediment	Cs-137	0.3070	0.0294	0.2776	4380	0.0002			
Shoreline	Direct Ground Exposure Average Dose - All Rads					0.0035			
Surface Soil Resuspension		pCi/g	pCi/g	pCi/g	m3/yr	mrem	**Total Soil Resuspension**		0.00
and inhalation	Pb-212	0.6010	0.5840	0.0170	8000	0.0000	Gamma Avg Dose	Gamma Total Dose	
	Cs-137	0.1800	0.1740	0.0060	8000	0.0000	0.0000	0.0001	
	Mn-54	0.0160	0.0000	0.0160	8000	0.0000			
	Ce-144	0.2650	0.0000	0.2650	8000	0.0000			
	Tc-99	5.1600	0.0000	5.1600	8000	0.0000			
Sediment	Cs-137	0.3070	0.0294	0.2776	8000	0.0000			
	Surface Soil Direct Ground Exposure Average Dose				All rads	0.0000			
Air Inhalation		pCi/m3	pCi/m3	pCi/m3	m3/yr	mrem	**Total Inhalation (LE)**		
Inhalation	H-3	5.7080	3.9750	1.7330	8000	0.0009			
	Alpha	0.0040	0.0039	0.00015	8000	0.3702	LE		
	Beta	0.0202	0.0191	0.0011	8000	0.0114			
	Air Inhalation Average Dose				**Avg**	**0.1275**			
TLD		mrem	mrem	mrem	hrs/day	mrem		**Ttl Absorbed Dose**	
Direct Exposure	**Direct**	82.66	85.97	-3.31	24.0	0.0000	**Offsite**	**0.00 offsite**	0.00
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		**Swimming Ingestion**	0.00
Ingestion	H-3	1718	313	1405	91	0.0008		0.001	
while swimming	Alpha	1.66	1.63	0.03	91	0.0000			
	Beta	2.56	2.33	0.00	91	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		**Swimming Immersion**	0.00
Immersion	H-3	1718	313	1405	91	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	91	0.0000			
	Beta	2.56	2.33	0.00	91	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		**Houseboat Exposure**	0.00
Boating	H-3	1718	313	1405	192	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	192	0.0000			
	Beta	2.56	2.33	0.00	192	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		**Swamp House Exposure**	0.00
Swamp Dweller	H-3	1718	313	1405	4380	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	4380	0.0000			
	Beta	2.56	2.33	0.00	4380	0.0000			
							MEI Radiation Dose		0.02

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only in Food Sources

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Food Sources								Total mrem/species	
Fish Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Fish mrem avg/rad	Bass	0.44
Bass	H-3	1.8970	0.0000	1.8970	48.2	0.006	H-3 avg dose	0.435	
	Cs-137	0.1780	0.0000	0.1780	48.2	0.429	0.004	Catfish	
				Bass	Avg	0.217		0.403	
Catfish	H-3	1.0430	0.0000	1.0430	48.2	0.003	Cs-137 avg dose	Shad	
	Cs-137	0.1660	0.0000	0.1660	48.2	0.400	0.415	0.001	
				Catfish	Avg	0.202		Mullett	
Shad	H-3	0.2850	0.0000	0.2850	48.2	0.001		0.004	
Mullett	H-3	1.4500	0.0000	1.4500	48.2	0.004		Fish Total Detect Dose	
								0.843	
Average Radioisotope Dose							0.209	Fish Average Dose	
								0.211	
Milk Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Milk mrem avg/rad	Milk Maximum Dose—	0.18
Cow	H-3	0.0000	0.0000	0.0000	230	0.000	H-3 or tritium	Cow Milk avg dose	
	Sr-90	0.0020	0.0015	0.0005	230	0.006	0.000	0.002	
	Cs-137	0.0042	0.0038	0.0004	230	0.001	Cs-137 avg dose	Cow Milk total dose	
milk solids	Sr-89	0.1407	0.0612	0.0795	230	0.169	0.001	0.007	
Goat	Sr-90	0.0030	0.0027	0.0003	230	0.003	Sr-89 avg dose	Goat Milk avg dose	
					Avg	0.036	0.169	0.003	
							SR-90 avg dose	Goat Milk total dose	
							0.004	0.003	
		Average Radioisotope Dose					0.044		
Game Animal		Average		Average Bkg					
Ingestion		Dose/Animal		Dose/Animal					
		mrem		mrem		mrem	Deer Avg Dose	Average Ingested Dose	
Average Deer	Cs-137	1.8900		1.05		0.84	0.84	0.84	
MEI Deer	Cs-137	Maximum Single Hunter Dose Consumption						MEI Deer Dose …………...	15.75
Edible Vegetation		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Veg Avg Dose	Edible Veg Total Dose	
Vegetable Fruit	H-3	0.5970	0.0000	0.5970	287.0	0.011	0.011	0.011	0.01
								MEI Food Dose	16.38

Notes: see the glossary section for radionuclide information.

*Alpha data calculated as Pu-239

*Beta data calculated as Sr-90

*MEI includes surface water instead of drinking water.

*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only in Water Sources

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose
Water Sources								**Total Dose (mrem)**	
PWS RW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	**DW mrem avg/rad**	River Water PWS Supply	**0.04**
Potable	H-3	489.500	245.000	244.500	730.000	0.011	Tritium (H-3)	0.040	
	*Alpha	2.970	2.120	0.850	730.000	0.032	0.013		
*Used Jackson Landing alpha detection as background.							Alpha		
	PWS River Water Average Dose					0.022	0.036		
PWS GW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	Beta	Groundwater PWS Wells	**0.05**
Potable	*H-3	299.600	3.231	296.369	730.000	0.014	0.000	0.054	
	*Alpha	3.718	2.656	1.061	730.000	0.040	DW Avg Rad Dose	PWS Total Dose	
*Used the average concentration of naturally occurring tritium in the environment.							0.016	0.094	
*SC PWS wells alpha background-average of 128 well samples in 2004.								PWS Avg Dose	
	PWS Well Water Average Dose					0.027		0.047	
DNR GW Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	DNR wells Avg Dose	DNRGW Ttl Dose	**0.02**
Potable	Alpha	1.303	2.656	-1.353	730.000	0.000	0.010	0.019	
	*Beta	3.880	1.700	2.180	730.000	0.019			
*Beta background is an average of 3 wells upgradient of SRS.									
	DNR Wells Average Dose					0.010			
GW & DNR	Groundwater Average Dose					0.018			
Potable Water Dose Average						0.019			
Water Ingestion		**pCi/L**	**pCi/L**	**pCi/L**	**L/yr**	**mrem**	Nonpotable Water		
SR Boat	H-3	838.000	201.000	637.000	730.000	0.030	H-3 Avg Dose		
Landings	Alpha	1.560	2.120	-0.560	730.000	0.000	0.022	Nonpotable Ttl. MEI Dose	**0.04**
Nonpotable	Beta	3.170	5.300	-2.130	730.000	0.000	Avg Surface Water	0.044	
Rainwater	H-3	293.300	3.231	290.069	730.000	0.014	0.016		
Nonpotable Surface Water Average Dose					**Avg**	0.011			
							MEI Drinking Water Dose (Highest)		**0.05**
						Drinking Water Sources Avg MEI Water Dose			**0.04**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI includes surface water instead of drinking water.
*See Table 2 and Appendix A for details related to this table.

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only For Soil, Air, and Surface Water

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Surface Soil Ingestion		pCi/g	pCi/g	pCi/g	mg/day	mrem	**Total Soil Ingestion Dose**		**1.22**
Gamma	Pb-212	0.8100	0.5500	0.2600	100	0.000	Gamma Avg Dose	Gamma Total Dose	
	Pb-214	0.9400	0.7600	0.1800	100	0.000	0.005	0.032	
See note*	U-234	1.988	0.6023	1.3857	100	0.001	Alpha Avg Dose	Alpha Total Dose	
	U-238	0.3837	0.3303	0.0534	100	0.000	1.189	1.189	
	Ac-228	1.1500	1.0500	0.1000	100	0.000	NORM Avg Dose	NORM Total Dose	
	Ra-226	1.9300	1.8500	0.0800	100	0.004	0.001	0.006	
Sediment	Cs-137	0.2000	0.0000	0.2000	100	0.026			
Alpha	as Pu-239	19.5000	10.3000	9.2000	100	1.189			
	Surface Soil Ingestion Average Dose				Avg	0.153			
Surface Soil Exposure		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	***Total Surface Direct Exposure Dose**		**0.19**
Direct	Pb-212	0.8100	0.5500	0.2600	4380	0.035	All Gamma Avg Dose	All Gamma Total Dose	
Exposure	Pb-214	0.9400	0.7600	0.1800	4380	0.046	0.027	0.191	
	U-234	1.9880	0.6023	1.3857	4380	0.000	Alpha Avg Dose	Alpha Total Dose	
See note*	U-238	0.3837	0.3303	0.0534	4380	0.000	0.001	0.001	
	Ac-228	1.1500	1.0500	0.1000	4380	0.109	NORM Avg Dose	NORM Total Dose	
	Ra-226	1.9300	1.8500	0.0800	4380	0.000	0.032	0.191	
Sediment	Cs-137	0.2000	0.0000	0.2000	4380	0.000			
Alpha	as Pu-239	19.5000	10.3000	9.2000	4380	0.001			
	Direct Ground Exposure Average Dose					0.024			
Surface Soil Resuspension		pCi/g	pCi/g	pCi/g	m3/yr	mrem	***Total Soil Resuspension Dose**		**0.19**
and inhalation	Pb-212	0.8100	0.5500	0.1290	8000	0.000	NORM Gamma Avg Dose	NORM Gamma Total Dose	
	Pb-214	0.9400	0.7600	0.1035	8000	0.000	0.029	0.175	
See note*	U-234	1.9880	0.6023	1.3857	8000	0.147	Alpha Avg Dose	Alpha Total Dose	
	U-238	0.3837	0.3303	0.0534	8000	0.005	0.010	0.010	
	Ac-228	1.1500	1.0500	0.0140	8000	0.003	All Pathway Gamma Avg	Total All Path Soil Gamma	
	Ra-226	1.9300	1.8500	0.0800	8000	0.020	0.020	0.398	
Sediment	Cs-137	0.2000	0.0000	0.2000	8000	**0.000**	All Pathway Alpha Avg	Total All Path Soil Alpha	
Alpha	**as Pu-239**	**19.5000**	10.3000	9.2000	8000	**0.010**	0.400	1.200	
	Surface Soil Direct Ground Exposure Average Dose				**All rads**	**0.038**			
Air Inhalation		pCi/m3	pCi/m3	pCi/m3	m3/yr	mrem		**Total Air Inhalation**	**0.00**
Inhalation	H-3	6.0550	3.0800	2.9750	8000	0.002			
	Alpha	0.0030	0.0030	0.0000	8000	0.000			
	Beta	0.0228	0.0230	-0.0002	8000	-0.002			
Air Inhalation Average Dose					Avg	0.000			
TLD		mrem	mrem	mrem	hrs/day	mrem			
Direct Exposure	Direct	93.45	93.20	0.25	24.0	0.250	**Offsite**	**Ttl Absorbed Dose**	**0.25**
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Ingestion	
Ingestion	H-3	883	244	639	91	0.000		0.000	
while swimming	Alpha	1.76	2.12	-0.37	91	0.000			
	Beta	3.25	5.30	-2.05	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Immersion	
Immersion	H-3	883	244	639	91	0.000	No H-3 exposure DF	0.000	**0.00**
Exposure	Alpha	1.88	2.12	-0.25	91	0.000			
	Beta	3.25	5.30	-2.05	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Houseboat Exposure	
Boating	H-3	883	244	639	192	0.000	No H-3 exposure DF	0.000	**0.00**
Exposure	Alpha	1.88	2.12	-0.25	192	0.000			
	Beta	3.25	5.30	-2.05	192	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swamp House Exposure	
Swamp Dweller	H-3	883	244	639	4380	0.000	No H-3 exposure DF	-0.001	**0.00**
Exposure	Alpha	1.88	2.12	-0.25	4380	0.000			
	Beta	3.25	5.30	-2.05	4380	-0.001			
						Total	**MEI Radiation Dose**	**Soil, Air, and SW**	**1.85**

Notes: see the glossary section for radionuclide information.
*Alpha data calculated as Pu-239
*Beta data calculated as Sr-90
*MEI includes surface water instead of drinking water.

6.1.4 Summary Statistics Radiological Dose Calculation

1999-2004 SCDHEC Detected Dose (mrem) Within 50 Miles of the SRS

	Year						6 Yr.	non-MEI	MEI	Statistics		
Media	1999	2000	2001	2002	2003	2004	Totals	% of Ttl	% of Ttl.	Avg.	SD	Median
Air	0.01		0.01	0.00		0.00	0.02	0.23	0.03	0.01	0.01	0.01
TLD	0.00	0.00	0.00	0.00	0.00	0.25	0.25	2.84	0.42	0.04	0.10	0.00
Soil	0.00	0.00	0.00	0.00	0.02	1.57	1.59	18.09	2.65	0.27	0.64	0.00
Sediment	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.30	0.04	0.00	0.01	0.00
Surface Water	0.04	0.09	0.03	0.05	0.07	0.04	0.32	3.63	0.53	0.05	0.02	0.05
PWSRW	0.03	0.03	0.01	0.02	0.03	0.04	0.17	1.90	0.28	0.03	0.01	0.03
PWSGW	0.00	0.00	0.13	0.00	0.02	0.05	0.20	2.27	0.33	0.03	0.05	0.01
DNRGW					0.02	0.02	0.04	0.45	0.07	0.02		0.02
Vegetables					0.01	0.01	0.02	0.23	0.03	0.01		0.01
Milk	0.04	0.05	0.00	0.00	0.09	0.18	0.36	4.09	0.60	0.06	0.07	0.05
Fish	1.08	0.32	0.27	0.61	0.30	0.44	3.02	34.28	5.02	0.50	0.31	0.38
Avg Deer		0.28	0.08	1.38	0.21	0.84	2.79	31.67		0.56	0.54	0.28
Total/Yr. Non-MEI Dose	1.20	0.77	0.53	2.06	0.77	3.47	8.81			1.47	1.12	0.99
MEI Deer		6.20	4.70	17.10	5.60	15.75	49.35		82.06	9.87	5.83	5.90
MEI Hog				4.77			4.77		7.93	4.77		4.77
Sportsman	0.04	6.52	4.97	22.48	5.90	16.19	56.10			9.35	8.50	5.90
Total MEI Dose	1.20	6.69	5.15	22.55	6.16	18.38	60.14			10.02	8.23	6.16

Notes:
1. "MEI" is the maximally exposed individual.
2. "Cs-137" is the radioisotope cesium-137.
3. "PWS" is public water system, "GW" is groundwater, "RW" is Savannah River water.
4. "DNR" is the Department of Natural Resources.
5. "Avg" is average, "SD" is standard deviation.
6. Sportsman is the dose from fish, deer, and hog.

Summary Statistics
Radiological Dose Calculation

Comparison of the 2004 Dose (mrem) to the Six Year Average					
1999-2004	Ttl. Dose	% of Ttl.	2004.00	Ttl. Dose	% of Ttl.
Cs-137	11.67	80.72	Cs-137	1.70	43.70
alpha	1.36	9.39	alpha	1.27	32.78
H-3	0.50	3.44	b-gamma	0.25	6.44
b-gamma	0.25	1.73	Sr-89	0.17	4.35
Sr-89	0.18	1.27	U-234	0.15	3.81
U-234	0.15	1.02	Ac-228	0.11	2.89
Ac-228	0.11	0.77	H-3	0.10	2.47
Pb-214	0.05	0.32	Pb-214	0.05	1.19
beta	0.04	0.30	Pb-212	0.04	0.90
Ce-144	0.04	0.28	Ra-226	0.02	0.62
Pb-212	0.04	0.24	beta	0.02	0.49
Ra-226	0.02	0.17	Sr-90	0.01	0.23
U-238	0.02	0.16	U-238	0.01	0.13
Sr-90	0.01	0.08	Sr-89/90	0.00	0.00
Sr-89/90	0.01	0.06	Ra-228	0.00	0.00
Am-243	0.00	0.02	Pu-239/240	0.00	0.00
Pu-239/240	0.00	0.01	Am-243	0.00	0.00
Pu-238	0.00	0.01	Pu-238	0.00	0.00
Tc-99	0.00	0.00	Ce-144	0.00	0.00
Ra-228	0.00	0.00	Tc-99	0.00	0.00

Notes:
1. This table uses the average game animal doses and not the MEI.
2. The recent inclusion of questionable NORM increased the alpha %.

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